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[The following are translations of selected articles in the Russian-language monthly journal AVIATSIYA I KOSMONAVTIKA published in Moscow. Refer to the table of contents for a listing of any articles not translated.]


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## History, Changes of Air Forces Aviation Engineering Service

*92UM1254A Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 92 (signed to press 23 Jan 92) pp 2-5*

[Article by Air Forces Chief Engineer Lieutenant-General of Aviation Gennadiy Nikolayevich Matveyev under the rubric "The Air Forces Aviation Engineering Service—50 Years": "The Aircraft is Ready for Flight..."]

[Text] *Such reports are invariably heard at our airfields during the flight shifts. Behind these laconic but capacious words lies the selfless labor of the largest portion of our flight personnel—the engineers, technicians and mechanics.*

*The Air Forces Aviation Engineering Service [IAS] as an independent service was formed in February of 1942. Air Forces Chief Engineer Lieutenant-General of Aviation Gennadiy Nikolayevich Matveyev relates its history and prospects for development.*

The structure of the IAS has constantly been improved to the extent of the increasing complexity of aviation hardware, improvements in its tactical performance characteristics and changes in servicing and technical characteristics, and has always been pursued in accord with the level of development of the organizational forms of the Air Forces.

The prototype of the contemporary aviation engineering service was the technical service of the aviation detachments that were formed in Russian military aviation by the start of World War I. Each aviation detachment had six aircraft and 38 personnel in its composition. The technical service was headed by the mechanic of the detachment, to whom was subordinate two senior engine mechanics (for tuning and adjustment of the aircraft and the engines), as well as engine mechanics assigned directly to the aircraft.

The air squadron, which included two or three aviation detachments, became the basic organizational entity of the Air Forces as of 1923. Its maintenance service was headed first by a senior mechanic, and then starting in 1925 by a mechanical engineer. The servicing of aircraft in the aviation detachment was supervised by the senior technician of the detachment, to whom was subordinate the master-rated personnel for the machineguns and the instruments. The direct servicing of the aircraft was accomplished by the technical crew, consisting of the technician, mechanic and engine mechanic.

Aviation brigades, consisting of three or four air squadrons, were formed to replace the individual squadrons starting in 1928. The logistical support for the aviation brigades was accomplished at aircraft parks that were organizationally part of them. All of this required the institution of substantial changes in the organizational structure of the technical maintenance service and, in particular, the introduction of greater specialization into the technical composition. Supervision of the maintenance service was exercised by its senior engineer. The positions of technicians for instruments, electrical equipment, armaments and repairs were introduced in the air squadrons that were part of the brigade for the first time. A mobile repair shop was moreover included in each of the air squadrons.

Technical servicing departments were created at the Air Forces staffs of the districts, and the position of chief engineer of the RKKA [Workers' and Peasants' Red Army] Air Forces was introduced in 1930 as a direct assistant to the chief of the Air Forces Chief Directorate on Questions of Technical Servicing of Aviation Hardware. The first "Manual for the Air Forces Technical-Maintenance Service" (NTES-33) came out in 1933.

Order No. 93 of the People's Commissar for Defense on 15 Apr 38 put into effect the "Statute on the Duties and Responsibility of the Officials of the RKKA Air Forces to Prevent Flights and Sorties in Unfit Equipment." The statute was reproduced and distributed to all flight and technical personnel. The phrasing of its first paragraph was very typical of our times as well: "The commander of the aviation brigade, unit, squadron, detachment or flight bears complete and total responsibility for the organization of procedures and regimens that would entirely rule out any possible sortie in unfit equipment."

The decision was made in 1938, based on battle experience in Spain and China, to convert the Air Forces to a regimental system, with the air squadrons downsized from 32-43 aircraft to 12-15. They began to create aviation divisions as the operational-tactical formations of the Air Forces somewhat later. The changes in the organizational structure of the Air Forces entailed changes in the technical-maintenance service of the aviation regiments as well. The service was headed by the senior engineer of the regiment, who had two deputies—an engineer for armaments and an engineer for electrical equipment and instruments. In the air squadrons it was headed by the engineer (senior technician) of the air squadron, directly subordinate to the commander, and in the flight by the technician of the flight. Each crew had an aircraft technician, a mechanic and an engine mechanic. All of these organizational changes were consolidated in a second manual—NTES-40.

In 1939 the rear services were removed from the aviation regiments and organized into independent rear units—the airfield servicing battalions (BAO), attached to the aviation regiments and combined into airfield basing regions (RAB). The RABs and BAOs had all of the repair equipment and personnel for performing routine maintenance of aircraft.

Intermediate repairs and major overhauls of the aircraft were under the purview of the Repair Directorate, created in 1939 and subordinate to the chief of the Supply and Repair Chief Directorate of the Air Forces.

The accomplishment of tasks in the technical servicing of aircraft during the prewar period was reduced to the organization and performance of the correct technical maintenance of the equipment, as well as the technical training of the flight and technical personnel of the units, the prompt discovery of design and production drawbacks in the aircraft and the taking of steps to prevent their failure in flight.

Completely new tasks arose during the initial period of World War II, including those such as the organization of intensive combat operations from unprepared field airfields and the operational redeployment of Air Forces units to new bases, the finding of opportunities for providing the combat regiments with spare parts and consumable materials, the

rapid restoration of aircraft with combat damage, the evacuation of aircraft from forced landing locations, the assimilation of new domestic and foreign aviation hardware under combat conditions, the organization of training for a large mass of young specialists and pilots and the preparation of reserve aircraft equipment in the rear units and institutions of the Air Forces.

The preparation of aircraft for combat sorties was complicated by the fact that the airfields were frequently under the effects of enemy aviation, and in certain cases artillery as well. Under conditions where individual regiments changed airfields ten times or more over the course of a month, the question of organizing the redeployment of the units and formations was an acute one. Transport was provided, as a rule, only for the advance team, with the rest of the technical personnel often forced to get to the new base location using passing transportation or by foot. The units were thus constantly experiencing shortages of technical personnel, and each mechanic had to service two or three aircraft.

The assimilation of new types of aircraft under combat conditions was an exceedingly difficult task for the technical-maintenance personnel. The aircraft in service, aside from domestic ones (Il-2, La-5, Yak-9 and Tu-2, among others), included Hurricanes, Tomahawks, Kitty Hawks, Aerocobras, Bostons, North Americans and others that were not adapted for operations under our climatic conditions.

An enormous amount of work was performed to make use of captured equipment and ordnance, especially during periods of energetic offensives by our troops, when the supply bodies were not able to support the forward airfields with domestic materials. They sometimes had to adapt captured aerial bombs for domestic fuzes or refine domestic aircraft for the purpose of hanging captured bombs on them in order to fulfill a combat operation.

The prewar organization of the command of the technical-maintenance service, as the experience of combat operations demonstrated, did not justify itself under the new conditions. The chief engineer of the Air Forces of the district or front did not have an apparatus through which he could supervise the technical-maintenance service of the units at the front. His apparatus had two senior engineers for servicing, one engineer for armaments and one for special equipment.

In the central apparatus the chief engineer of the Air Forces of the Red Army, directly subordinate to the first deputy chief of the Air Forces Chief Directorate and simultaneously the chief of the 2nd Directorate (Technical Maintenance) of the Air Forces Chief Directorate of the Red Army, also did not have sufficient manpower and equipment to provide for full-fledged supervision of all realms of activity of the technical-maintenance services. The subordination of the repair bodies to the chief of supply and repair for the Air Forces CD of the Red Army, for example, and not to the chief engineer of the Air Forces of the Red Army, was in contradiction to reality, since one of the principal tasks in the activity of the technical-engineering personnel at all levels was the organization of the rapid restoration of damaged aircraft equipment.

It was necessary to take urgent steps to improve the structure of the service directorate, and the technical-maintenance service of the Air Forces went through several stages of re-organization (it began to be called the technical-engineering service as of 1942) during the period from August 1941 through February 1942. The Chief Directorate of the Aviation Engineering Service—at the head of which was placed the Chief Engineer of the Red Army Air Forces—was created in February 1942 on the basis of the Servicing and Repair Directorate of the Air Forces of the Red Army and the Experimental Construction Directorate. It was Lieutenant-General of Aviation I. Petrov from March through June of 1942, when he was replaced by Colonel-General A. Repin, who remained Chief Engineer of the Air Forces until the end of the war.

The Chief Engineer of the Red Army Air Forces was a deputy commander-in-chief of the Red Army Air Forces for the Aviation Engineering Service and a member of the military council of the Air Forces. The Servicing and Repair Directorate was re-organized into the Technical Servicing Directorate and the Repair Directorate. Changes also occurred in the organization of IAS in the field. The headquarters of the aviation regiments and air divisions had introduced the position of engineers for field repairs, and repair departments and technical-servicing departments, as well as an editing and publishing department, were created under the chief engineer in the air army of the Air Forces in the front or district.

People's Commissar for Defense Order No. 201 of 28 Jun 42 and Air Forces Commander-in-Chief Directive No. 13843 of 12 Aug 43 defined the tasks, legal status and responsibilities of IAS officers—from the engine mechanics to the chief engineer of the Air Forces.

The next Manual for the Aviation Engineering Service came out in 1943, and it reflected the experience of the war and clarified changes in the organization of the IAS.

The engineering and technical personnel supported more than three million sorties over the war. The aircraft repair system and the technical-engineering personnel of the units carried out 1.65 million aircraft-repairs (of which 53,500 were major overhauls or intermediate repairs, comprising about 50 percent of the overall quantity of aircraft put out by industry during the war years). Some 3,500 aircraft were salvaged from forced-landing locations as well. Twenty new types of aircraft and engines and dozens of the latest types of aviation equipment and armaments for the times were assimilated in the course of the war. Modernization work was conducted on thousands of aircraft.

The military labor of engineers, technicians and mechanics was highly regarded. More than 50,000 of them were awarded decorations and medals of the Soviet Union.

The intensive re-armament of Soviet aviation began during the postwar period. The first jet aircraft began arriving in 1947-48. They were the Yak-15, MiG-9, MiG-15 and La-15 fighters. The Il-28 and Tu-14 jet bombers arrived in the units in the middle of 1949. The complexity of those aircraft required a rise in skills and a further specialization of the engineering and technical personnel, as well as changes in the forms and methods of organizing technical maintenance for the aircraft and their basing conditions. The Manual of the Aviation Engineering Service (NIAS-52) was published in this regard in 1952.

It was now impossible to man each crew with specialists in every field, test and measurement equipment, tools and devices for the new aircraft. The required amount of work on each aircraft increased so much that it could not now be performed by the manpower of just one crew.

The year 1954 was a most important milestone in the history of the IAS. Fundamental changes occurred in the system of technical maintenance for aircraft equipment. A transition was made from a crew-by-crew method of servicing aircraft to a group system of technical maintenance for it. The engineering and technical personnel were combined into groups formed by dedicated purpose (maintenance, routine inspection and servicing, monitoring and repair, among others) and by certain fields (aircraft and engine, armaments, aviation equipment and electronics equipment, among others) under a group system of technical maintenance for the aircraft. The groups for routine inspection, servicing and repair were reduced to an independent subunit—the technical-maintenance unit of the aviation regiment (TEChap). The NIAS-56 consolidated all of these changes in 1956.

The 1960s were a new stage in the development of the Air Forces. A new generation of supersonic and missile-carrying equipment arrived to arm the units: the multirole MiG-21 fighter came to replace the well-known MiG-15 and MiG-17, and it became the principal aircraft of frontal aviation in the 1960s; the Su-7B became the forefather of many fighter-bombers; the assimilation of the first Tu-22 long-range supersonic bomber began. Various electronic gear arrived at the same time that expanded the opportunities for the application of aviation.

The combat capabilities of the aircraft have risen under the influence of technical progress. The operational-tactical requirements posed toward the aviation units of the Air Forces have changed. The demands made on the IAS to support the combat operations of aviation units have also risen accordingly. A chapter dedicated to the organization of engineering aviation support (IAO) for combat operations was thus introduced in NIAS-64 for the first time. That manual also devoted a great deal of attention to questions of ensuring the reliability of aircraft operation.

The Air Forces have gone through several more stages of development over the last twenty years, connected with the succession of generations of aircraft. The experience gained by the IAS at each stage was analyzed and consolidated in the corresponding manuals for the aviation engineering service.

Analysis and summary of the experience of organizing combat operations in the Republic of Afghanistan—where the engineering and technical personnel had to perform the tasks entrusted to them under the most difficult conditions of the mountain and desert terrain—has great significance. The harsh climatic conditions, heavy dust content of the air and the operation of the aircraft in maximum modes all required great endurance and a high feeling of responsibility and professionalism from the technical and engineering personnel.

It was especially difficult to prepare the combat hardware for repeated flights under conditions of an acute shortage of time, to restore damaged aircraft at places of forced landings and to support the combat operations of small groups of aircraft and helicopters with their autonomous basing. The work on the aircraft equipment was performed, as a rule, by technical crews created for the performance of field repairs, for the preparation of the aircraft for repeated flights, aviation weaponry (ASP) etc. This experience was later taken into account when improving the standard organizational structure of the IAS and the system of technical maintenance for aircraft equipment.

The experience in organizing aviation engineering support in the Republic of Afghanistan proved convincingly once again that the system of technical maintenance and repair of aircraft equipment should be uniform for peacetime and wartime.

The improvement of aircraft in the 1970s and 1980s led to even greater sophistication of the aircraft with complex and varied equipment and to a sharp increase in the degree of its complexity. This evoked the necessity of developing and incorporating a new system of organization for the technical maintenance of aircraft equipment. This issue has been covered in detail in the pages of AVIATSIYA I KOSMONAVTIKA, for example in the article "Why Does the System Need a System?" (1992, No. 1).

The adoption of a new system of technical maintenance for aviation hardware entails certain difficulties, of course. A whole series of technical, organizational and social issues still have to be resolved.

The further improvement of the Air Forces that is being implemented within the framework of the overall reform of the armed forces conditions the specific features of the development of the IAS. The problem of minimizing spending on the servicing of aviation hardware with the preservation of the required indicators of its reliability and of flight safety has become especially topical at the current time. The implementation of a step-by-step transition of aviation hardware and guided ASP to service and repair per condition is envisaged to be carried out by 1995-2000 for that purpose. The accomplishment of this task is closely interconnected with a sharp cutback in the range of types of airframes and the realization of the principle of the standard base airfield. This should ultimately provide for a cutback in the types of spare parts and ground servicing equipment, a simplification of training for flight, engineering and technical personnel, a reduction in the required specialization of the aircraft repair facilities and a considerable economy of funds through cutbacks in spending on the servicing of the aviation hardware.

The transition to the system of servicing and repair per condition will require changes in the look and structure of the IAS. Subunits of technical squadrons for preparation and technical squadrons for diagnostics and routine maintenance will be the foundation of the structure of IAS in the regiment. Their core will be the standard technical teams (crews) of four to ten specialists (depending on the type of aircraft) and the repair group.

The division of the IAS into two parts—stationary and mobile—is being proposed in an organizational regard. The stationary is conditioned by the necessity of reducing the amounts of IAS matériel and other assets being redeployed when maneuvering the aviation regiment. It includes the technical squadrons for the servicing and preparation of the ASP, the repair of equipment that has been taken out,

groups for the routine servicing of stationary and mobile technical maintenance and repair equipment, as well as a training base, simulators etc. The mobile portion of the IAS will include all the engineering and technical personnel of the regiment and mobile servicing and repair equipment, including small-scale mechanization equipment.

The creation of highly developed bodies for field repair right in the aviation regiments and the assurance of the maximum degree of mechanization of operations in the preparation of aircraft for combat sorties, as well as the formation of powerful diagnostic and routine repair centers for aircraft using automated monitoring systems of their technical state, is envisaged for the purpose of increasing the effectiveness of the IAS as an independent, and one of the principal, types of support for combat operations.

The improvement of the IAS is inseparably linked with raising the professionalism of engineering and technical personnel. On that plane, as well as taking into account the increasing complexity of the aircraft coming into service, the adoption of a comprehensive system of professional training for engineering and technical personnel is being proposed in the next two or three years, providing for a transition to new courses for combat training, the retraining of the engineering and technical personnel at retraining centers and higher educational institutions and transition to a system of orders for specialists with higher and secondary education. The ultimate aim is the training of the engineering and technical personnel to a level that will support servicing and repair per condition and autonomy of operations at a base airfield for the preparation of all types of aircraft in service with the Air Forces for combat sorties.



## Training, Service Problems of Army Aviation Bemoaned

*92UM1254B Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 92 (signed to press 23 Jan 92) pp 6-7*

[Article by Army Aviation representative Military Pilot 1st Class Lieutenant-Colonel V. Likhachev under the rubric "Combat Training: Experience, Problems, Opinions": "In the Fog of Impending Changes"]

[Text] *We are continuing the discussion of the article by Lieutenant-Colonel V. Vysotskiy "The Stumbling Block, or The Problems of Combat Training" (AVIATSIYA I KOSMONAVTIKA, 1991, No. 11). Army Aviation representative Military Pilot 1st Class Lieutenant-Colonel V. Likhachev shares his thoughts.*

About twenty years have now passed since the moment when I, gripped by high hopes and prospects for the future, plunged into the world of aviation upon completion of flight school. And today I often ask myself, from the standpoint of the years I have spent in it, How perfected is our current system of training for the warriors of the air, and fliers of all fields in general?

I confess that the greater portion of the theoretical knowledge that they crammed me with to overflowing in school (one can understand the instructors, who are paid by the class hours spent) was not suited to practice and, I think, will scarcely be suitable now. I do not say this lightly, as I am convinced that we cannot train professional pilots the way we are doing it today. The time has long since come for special schools for initial flight training (matters are not yet proceeding beyond the opening of two such schools), which would "work" for all of aviation and where the young people, aside from general disciplines, would master the rudiments of their future profession, while experienced instructor pilots would determine their individual abilities and prospects for service in this or that branch of aviation.

The circumstance that the young person would gradually be plunging into living conditions new to him is also of no small importance to him—his parents' home, after all, and his usual circle of acquaintances and friends are not far away. Today, in the event he enters a flight school immediately after completion of secondary school, he runs into tough army reality. But the way back is already cut off—he has sworn his loyalty to the Motherland! And when the flights start, it becomes clear to many of them that all of their notions about aviation (formed from books and movies for many of them) absolutely do not conform to reality. And not a trace of romance remains in the subjugation of the Fifth Ocean.

So then, such schools are needed so that there are as few such instances as possible, so as at least to improve the professional selection of future fliers. One could also think about the question of paid training (within reasonable limits, of course) and material support for the schools on the part of sponsors who, I am sure, could be found if they wanted to.

As for the flight schools, the term of study inside their walls should be cut back to two years provided, of course, that the future pilot is purposefully trained for what he will need in future flight work. Purposeful training should be understood to mean not only the performance of flights, but also the unwavering observance of requirements; no details and housekeeping chores—everything should be subordinate to one thing, flight training. The possibility of having graduation from the schools in the spring rather than the fall, as is the case now, would appear with its maximum intensity, so that the young pilots could complete their theoretical and practical cross-training for the combat hardware at the training center by the summer and then continue to master it in the line unit. From there... everything depends on the pilot himself—his advancement according to the program of flight training and in the service.

I feel, by the way, that all assignments of flight personnel to higher posts should be made—without exception—not only on a competitive basis, but with the mandatory mastery of its rudiments at special courses of study (flight, squadron and regimental commanders) at centers for the combat application and cross-training of the flight personnel of all branches of aviation. You will agree that a newly assigned commander sometimes has to be guided in his new position just by the principle of "do things the way my senior comrade did them before me." But candidly speaking, not every "senior comrade" helps his subordinate correctly and on a high professional level.

Something about professionalism, by the way. I agree completely with the opinion of V. Vysotskiy that we are overrun in our aviation with Masters of Papers and Orders for all

instances in life. Ask any pilot how many different performance-graded tests he has had to take over his years of service. And he will tell you, I am simply sure, in any case no less often than he has had to go up into the air. We have already become accustomed to the fact that after the latest flight accident, no matter what type of aircraft or helicopter it was on, the Flight Safety Service will send out circulars that all flight personnel must take a performance-graded test in this or that discipline.

And so all the pilots, from the rank-and-file pilot to the regimental commander, "sit down at their desks" and start... I think the fliers can guess what I am talking about. Yes, formalism has thoroughly permeated our combat training. It could be no other way under the System that exists today. The enormous quantity of "guiding" documents, after all, has led to the fact that none of the fliers knows clearly his own immediate duties, does not know what he answers for and ultimately what he is being paid money for!

The unspoken "it will come to no good" that has taken root in aviation has engendered lots of contrived prohibitions. I recall the period of development of the last Combat Training Course for army aviation. So many brilliant and bold ideas were expressed then! A long-awaited opportunity had appeared, it seemed, to raise the level of professional fliers substantially, to expand the realm of application of the rotary-winged craft, to finally give the regimental commander the freedom to train the crews... Nothing of the sort! They sent down restrictions, cancellations and prohibitions from above. They were able to hold out on at least a few things with enormous labor. But even those few things proved not to be needed by a single commander. Why?! The simpler the better, better if nothing happens. That is how we live and fear. When a person knows firmly what he answers for, and that requirement is always adhered to, he is proud and independent. The System, however, needs the cowardly slaves that we remain to this day, until we destroy it.

I feel that it is long since necessary to adopt a Flight Service Law—a fundamental document that would be written in simple language, in businesslike fashion, without appeals and slogans. Then there would be no differences in the procedure for organizing flights, their execution or the investigation of flight accidents and the precursors to them. Everything in the life of the fliers would become subordinate to the requirements of just one document—the Law. I would note that, in my opinion, it should reflect questions not only pertaining to combat training, but also touching on the social problems of military fliers.

Why, for instance, are fliers going into retirement as early as 35-40 years of age, compared to other specialists? Those are the very years when they gain flight wisdom along with their experience and maturity! They become solid, in other words! But... if by that time they have been unable, for a variety of reasons, to achieve a certain service position (once again commensurate with their age), they automatically become prospectless. So here is a still young man, striving not to cede his chances for a service career, going for the top grades. And a kind of conflict takes shape in the pilots' environment—the "old-timers" feel circumvented, and their opinions are now often not even listened to. Then they face a choice: isn't it time for a well-deserved rest, the difference between pay and pension is nothing these days—150-250 rubles? It is even strange to some extent that those who are past thirty stay in the flight profession—the romance of the flight profession, love of the sky? Perhaps there are other reasons?

It is difficult for me to agree with the assessment of the professionalism of the pilot that was given by Lieutenant-Colonel V. Vysotskiy. That pertains especially to his physical training and the state of his health. It is bad, of course, if the pilot smokes, and even worse if he drinks. No one, however, will be able to eradicate these nasty habits with prohibitions alone (which we have tried more than once). The whole form of the vital activity of the fliers has to be changed. That same physical training (I emphasize, physical training and not sports) should be conducted under the supervision of a teacher daily, and become planned rather than random. The military doctors should of course have their say on this matter, and a true battle against smoking should be waged. I feel that it is simply incorrect, however, to divide pilots into smokers and non-smokers today. And that is not a criterion for assessing their level of professional training.

As concerns some deviations in the state of health of the pilot, the physical demands that they are constantly experiencing in the air over the years, as is well known, cannot fail to have an impact. It is impossible, in no case can he be taken out of the air. He may not be as stately as, say, an airborne officer, but he is, after all, a Master and will remain so. Just give him the opportunity, if not to advance along the service ladder, to at least live under normal conditions and work professionally. If he is not now suited for flights in a fighter according to the state of his health, perhaps he could be transferred to military transport or army aviation. The experience that he has acquired in hundreds of sorties, after all, cannot be bought for any amount of money! A Master can be lost with the stroke of a pen—"discharge!"

The size of our Air Forces should undoubtedly be cut back, and significantly. But allow me, just what are we doing? The professionals leave, and then who remains? Would it not be better to take the path of of cutting back the acceptance of cadets into the higher educational institutions, permit all young fliers who want to to go into civilian life (they will be able to set themselves up in life there) and keep in the ranks, at any cost, the experienced pilots, without whom, I am convinced, aviation would soon begin to wither away?

Speaking of professionalism, I cannot help but dwell on the following. I will not take it upon myself to judge the state of affairs in the other branches of aviation, but the fact that in army aviation the requirements of the Air Forces commander-in-chief to train the flight personnel by class and the confirmation of their class rating has long since ceased to be a criterion for evaluating the true flight mastery of the pilots—this is a fact, since the principle of "maybe badly, but the same way" reigns supreme today. It is incomprehensible, you will agree, how one and the same requirements can be posed for the aerial proficiency of the crews of combat, transport and combat/transport helicopters. It is entirely natural that the leveling that has taken root in flight practice is slowing down the growth of pilot mastery. Many, having reached certain peaks of it, continue to fly relying only on the experience they have gained without having any opportunity to improve it due to various types of restrictions. Evne though I myself know that many pilots are up to

the performance of much more difficult tasks than those that are stipulated by the Combat Training Course.

I also cannot leave another issue without attention. I think that every pilot (especially at a mature age) will find it difficult to recall from his own practice when he was given an evaluation below "good"—the more so taken off flights—after a regular check of some type of flight training. It is then asked, why so many checks? Who needs them, the procurator? To all appearances, yes. Notebooks of training for flights, about the "use" of which heated debates have been waged in our Air Forces for more than a decade now, are filled up for him. No one, however, has as yet been able to convince our aviation officials of the fact that this notebook, however much may be written in it, is no help in the air if—pardon the expression—the head is empty. And as for responsibility (those same officials care about that more than anything), no one is taking it away from the commander for pilot training.

In conclusion I would like to express my opinion in relation to the decline in prestige of the flight profession. How could it not drop when the pilot is considered to be the representative of a courageous and heroic profession only if he is in the cockpit of the aircraft? But outside the cockpit... I will not talk about the fact that the monetary sustenance of the fliers and technicians does not correspond to the labor they expend (it is boring already); that is characteristic of any profession in our country today anyway. I want to say something else. The fliers have always been distinguished among the representatives of other branches of service by their uniform. Yes, yes, don't take it for a banality, but the profession of pilot has rather enjoyed the respect and love of the people to a certain extent for that reason nonetheless.

But what about now? The flight uniform is either for a tractor driver or something else; the everyday one is in no way an aviation one. I understand that now is not the time for verbose discussions on this problem, we have to think about a morsel of bread. All true. But one could, with some good thinking, review the terms for wearing various uniforms for fliers and develop more comfortable types of it. The parade uniform, for instance, could be distinguished from the everyday just by the color of the shirt. And what that is flattering could be said about our celebrated overcoat? Just what techniques of hand-to-hand combat could be employed in it? It is too heavy to hold up your arm, and running in it—the flaps get in the way. If it is below twenty degrees, then it will warm you, if only you put on a sweater and wool pants. Have all of our rear-support personnel not really experienced these inconveniences? But meanwhile...

I have always considered myself an optimist, but I admit that I look to tomorrow with sadness. Why? Because I am sure that once having started the discussion in earnest of a radical restructuring of the process of combat training, that restructuring must begin "above." And the state of affairs in aviation will not change for the better by trying to stir up the "lower ranks" with a discussion of the problems that have set their teeth on edge.



## Rush to Place Blame Obscures Causes of Flight Accidents

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[Article by Military Pilot 1st Class Colonel Yu. Timchenko, Colonel S. Shumilo, an editor at the Flight Safety Department, and senior research engineer Lieutenant-Colonel S. Bolotin under the rubric "Flight Safety: Experience, Analysis, Problems": "Is the General Always Right?"]

[Text] *"Punishment for a mistake is not a means of preventing a flight accident, since it does not eliminate the causes that gave rise to it, but it creates the illusion of steps taken, traumatizes the psyche and reduces the effectiveness of subsequent preventive measures, if they are taken..."*[1]

Squadron Commander Lieutenant-Colonel B. Chernyavskiy and Flight Commander Captain A. Kazmin were to test-fly an aircraft on their next sortie after the replacement of the left engine. That flight assignment is a special one, and requires special training, complete mutual understanding between the members of the crew and teamwork in their actions.

So here is the aircraft racing along the runway. Lift-off of the front wheel, and in an instant the aircraft is headed into the sky...

B. Chernyavskiy relates, "At an altitude on the order of 10 meters the revolutions of the right engine dropped to 80 percent. There was a slight shaking and slippage to the right. Since we were checking out the left engine, disruptions in its operability and possibly even failure could not be ruled out (and there was a city lying directly ahead), so I made the decision to land even though according to the RLE [aircraft operating manual] I should have continued the takeoff using the one operating engine. At my command Kazmin set the landing-gear lever to down, but the struts would not go down. The aircraft was damaged in descent onto the stopway..."

A commission assigned by order of the commander of the formation immediately flew out to the location of the accident. They studied the circumstances that led to the PLP [precondition for a flight accident] in detail, the specific features of the training of the flight crew for the flight, the organization of flight operations, the correctness of the technical maintenance of the aircraft on the ground and in the air and the documentation, among other things. Intensive work, sleepless nights—and the unanimous decision that was reached was that the cause of the PLP was crew error in operating the aircraft as expressed in retracting the landing gear at an impermissibly low altitude and the unintentional throttling back of the right engine therein to "idle." The takeoff of the aircraft was made with the periscope retracted, which did not permit the instructor to assess the situation correctly.

The corresponding measures were developed, aimed at preventing similar accidents in the future.

We will not call into question the correctness of the conclusions of that commission. A dangerous precondition to a flight accident had occurred, however. The manpower of the regimental technical-maintenance unit (TECh) was not able

to repair the aircraft. If the cost of repairing an aircraft by an aviation enterprise exceeds a stipulated one, the damage is turned into scrap, and the precondition into a flight accident. The essence has not changed, at first glance—the crew is alive, the aircraft is damaged. But the materials of the case are transferred to the procuracy in the case of a flight accident, and here material liability for the damage caused lies in wait for the "guilty party."

We have been taught since childhood that there is always room in life for the heroic deed, and that a "bad" deed that is committed should be punished. But they managed here without that.

The guilty parties were established and "educational" measures were defined by order of the commanding general of the formation, Lieutenant-General of Aviation A. Strogov. The crew was permanently removed from flights, and the flight operations officer was forced to seek a new position. All of the victims and their comrades-in-arms, however, did not agree with the commander's decision. A commission of specialists from the Aviation SBP [Flight Safety Service] of the USSR Ministry of Defense was thus assigned by decision of the Air Forces commander-in-chief to do a repeat investigation of this dangerous precondition.

Many difficulties have arisen in our army life that are of both an objective and a subjective nature. They are revealed more strongly in flight activity in view of the specific nature of it. Everyone already knows that the number of flight personnel in the aviation regiments considerably exceeds the standard level for humanitarian reasons. It is impossible to provide every pilot with the required flying time in that situation. And there is also not enough fuel, and oil and spare parts are lacking. The average flying time for a pilot over the first 10 months of 1991 was less than 40 hours in that regiment, and there were no prospects of fulfilling the stipulated norms. No fuels and lubricants will be coming before the end of the year. But after all, if the pilot does not complete the flying time assigned by directive, there will be no favorable computation of service time. How is he to blame here? The young men are dying to get into the sky, they have been taught to fly, but there is no opportunity to do so. Perhaps it would be expedient to abolish all sorts of flying-time norms in such a situation? They now lead just to exaggerated records. The surplus of recorded time over the time determined according to the instruments reaches 30 percent in certain cases. It would perhaps be more humane to dismiss those who have the right to pension support, and train true aerial warriors from among the rest? The pilots are still languishing while waiting for the right to fly, and when they do go up, the commanders suffer—will the pilot return to his own airfield, having such "enormous" experience? The scientifically substantiated flying-time norm to maintain piloting skills is 160-180 hours, 220-240 hours according to foreign sources. Just who are we training?

The members of the Air Forces commander-in-chief's commission, having researched the hardware and the materials from the objective recording equipment, proved convincingly that the throttle could not have moved independently to idle in that situation. They established that the appearance of the dangerous PLP was facilitated by serious omissions in the organization and support of flights and the preparation of the crew for them.

One of the causes for the PLP, aside from this, was the incorrect perception of the situation by the crew and the erroneous decision to land the aircraft when there was the possibility of continuing the takeoff. The squadron commander moreover violated operating procedures with the aircraft controls, which led to the uncontrolled movement of the throttle from the "maximum" position to "idle" in takeoff. The pilots deny the fact of the throttle setting at "idle." The squadron commander, however, could not recall precisely whether he kept his hand on the throttle during takeoff.

It is incomprehensible—why was the flight commander taking up the aircraft while the squadron commander was in the instructor's cockpit?

The commission did not make it its business to find the "guilty party." Its main task consisted of establishing the reasons for the precondition and developing preventive measures for the purpose of preventing similar incidents in the future.

Only one question arises—why did the directive of formation commander Lieutenant-General of Aviation A. Strogov take the word "unintentional" out of the phrasing of the cause of the PLP established by the commission in relation to the movement of the throttle? Not with the aim of strict punishment for the culprits?

The pilots of the regiment appealed to the commander with the request to reduce the punishment. It was said in reply that a commander cannot be a coward...

The commission deemed the actions of the flight operations officer to be correct in this specific situation. The crew did not conduct any radio communications. After the aircraft touched the runway the flight operations officer gave the command to turn off the engines and deploy the braking chute, and warned the crew that he was raising the emergency braking device. He could hardly have done any more over a few seconds. Why he was dismissed is thus known only to General Strogov. It was, after all, namely he that approved the Instructions for the Performance of Flights in the Area of the Airfield, according to which the performance of flights without an assistant flight operations officer—who had not been designated—was permitted in violation of the requirements of NPP-88.

We will not debate the severity of the punishment, but is it logical that a trained specialist can be dismissed from his work by the will of one person and no one can help him? And this is not an isolated case.

The sky, blue unlike autumn, portended no "threat." A team from the PVO [Air Defense] Aviation Directorate came out on 26 Sep to prepare for a demonstration flight in a MiG-31 fighter at Kubinka airfield, so as to demonstrate its qualities for a high "overseas" military leader. It was not a difficult task at first glance—takeoff with a minimum fuel load at full afterburners, a smooth increase in the pitch angle to 40-45° after separation and retraction of the landing gear without permitting any fluctuations or reductions in speed. They were to make a standard turn after reaching an altitude of 2,500 meters with entry onto a parallel heading with a drop in altitude to 100 meters. Then they were to turn on the afterburners while passing over the takeoff area at a speed of

900-950 km/hr and make a steep climb with an angle of 70° at four Gs with subsequent approach for a landing.

They chose two of the best crews—Lieutenant-Colonel A. Kozachenko and Lieutenant-Colonel V. Kurdyukov, and Major S. Shapovalov and Lieutenant-Colonel M. Subbotin. The check and solo flights were made on 27 Sep with good and excellent quality. Small deviations made by Major S. Shapovalov were analyzed in detail together with his squadron commander, Lieutenant-Colonel A. Kozachenko. They once again "ran through" the assignment and thought through all of the dangers that could lie in wait for the pilot on that flight on Saturday, 28 Sep, at the preliminary preparations.

"Don't pull, don't pull... the right leg..."—those were the last words that Major Sergey Shapovalov, military pilot 1st class, with more than 1,300 hours of flying time, commander of a MiG-31 fighter detachment, heard in his life, dying in an air crash on 30 Sep 91.

The aircraft navigator, Lieutenant-Colonel Mikhail Subbotin, remained alive. It was he who had been shouting to the commander and, when he understood that the situation was hopeless, pulled the ejection seat. Would it were second sooner... Here are lines from the report of the crash investigation of the MiG-31: "At 12:13 a crew consisting of detachment commander Major S. Shapovalov and deputy chief navigator Lieutenant-Colonel M. Subbotin executed a takeoff from the base airfield. In the first minute of the flight, in the zone of responsibility of the flight operations officer, after separation and the transition of the aircraft to gaining altitude at a speed of 390-400 km/hr, the pilot created a pitch angle of 40° through the energetic movement of the stick toward himself for 2-3 seconds, which led to the entry of the aircraft into stalling angle of attack and its stall at an altitude of 150 meters with transition to a descending trajectory at a pitch angle of 50-60° and increase in left roll to 90°. The actions of the pilot in this situation were incorrect: the stick and the pedal were pushed to the right to offset the left roll, which aggravated the situation and facilitated the stall of the aircraft at smaller angles of attack and higher speed. The pilot was unable to assess the situation correctly due to the rapidity of the development of the emergency situation and the lack of altitude, and did not make the decision to eject. The ejection of the crew was made by decision of the navigator. The navigator was not injured. The crew commander was killed due to the lack of altitude and the large vertical velocity of the aircraft descent. The flight operations officer issued the command to eject too late... The guilty parties for the flight accident have not been determined..."

When these lines were written the guilty parties, despite the conclusion of the commission, had already been determined. They became, by the will of the Chief of PVO Aviation Lieutenant-General of Aviation V. Andreyev, the commander of the squadron, Lieutenant-Colonel A. Kozachenko, and the chief of the Center, Major-General of Aviation Yu. Novikov. The flight parameters recorded by the "black box" were reduced to ashes together with the aircraft.

Yes, it is naturally necessary to answer for the death of a person. But the guilty parties are determined by a court in civilian life. The guilty parties in the military are often designated proceeding from the principle of "let things fall where they may": "heads roll" and fates are ruined.

But isn't the hasty determination of the guilty parties a cover for one's own blunders, sacrificed at the altar of the military-industrial complex, oh so powerful even today? The absence of an indicator of the angle of attack on this type of fighter has always been considered by specialists to be dangerous. And this was all the more strange as the chief of PVO Aviation had fought for the study of dangers by pilots. But it is one thing to study them, and another to take steps to eliminate them, including those that exist in the aviation system itself.

"Lieutenant-Colonel A. Kozachenko—an excellent specialist in training methods, military pilot-expert marksman. Prepares carefully for every flight"—that is the inscription on the photograph in the eighth issue of the VESTNIK PVO for 1991. In 1986, when an accident occurred with the deputy commander of the air squadron for political affairs, Captain S. Karpov, his portrait disappeared from the garrison's Board of Honor over one night. The words written in black and white and the photograph of A. Kozachenko cannot be cut out of all issues of the journal, no matter how hard one tries.

"... I... decided not to shoot from the hip and to try and study the problem of flight safety as part of a whole... two accidents occurred, and young pilots died... Yazov, without investigating the causes of the accident, ordered that Andreyev be removed..." These are lines from an interview given by the "disgraced" General V. Andreyev a little over a year ago to LITERATURNAYA GAZETA (No. 39 (5313), 26 Sep 90). "Who protects the generals?"—that is what the article was called. Democracy defended General Andreyev. But who protects the pilot?

**Footnote**

1. *"Rukovodstvo po predotvrashcheniyu letnykh proisshestviy v aviatsii Vooruzhennykh Sil SSSR"* [Manual on Preventing Flight Accidents in USSR Armed Forces Aviation]. Moscow; Voyenizdat Publishing House, 1990, p 37.



## Flap Malfunction Causes Fatal MiG-23UB Crash

*92UM1254D Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 92 (signed to press 23 Jan 92) p 12*

[Article by Colonel V. Barachenkov under the rubric "A Special Case in Flight": "Guilty of the Death of the Crew?"]

[Text] The crew of a MiG-23UB was returning to its airfield from an assignment. The pilot, having executed all of the necessary pre-landing maneuvers and actions with the equipment, brought the craft onto its landing heading and began to descend. The aircraft was submitting to control actions in clear-cut fashion, as was confirmed by reports over the air.

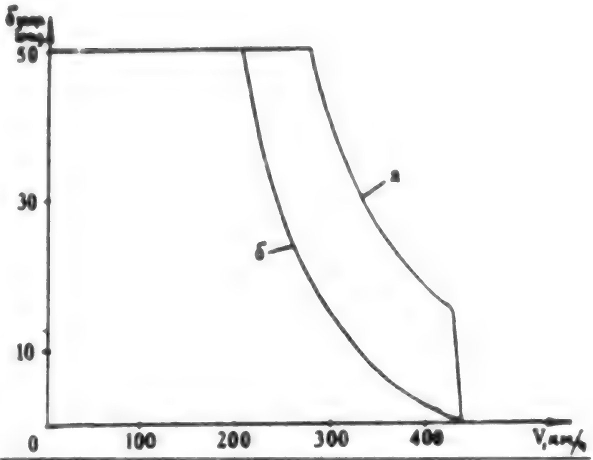
The situation changed sharply at the stage of roundout—the aircraft suddenly started to heel to the right. The landing occurred with the right landing-gear strut ahead with the subsequent deviation of the aircraft off the runway. There later occurred a repeated touchdown of the right landing-gear strut and right wingtip at an angle to the runway axis.

The flight operations officer [RP] was observing the abnormality in the landing of the aircraft and, taking it for an error by the pilot in his flying technique, gave the command to increase engine revolutions and come around for a second approach, which the crew did. To the RP's inquiry of "What happened?" the pilot reported, "Control failed." The aircraft, continuing its takeoff at maximum engine operating mode, separated from the runway with increasing right heel.

Having determined that the angle of attack was somewhat more than usual, the flight operations officers gave the command to reduce it. The roll reached an angle of more than 70° at an altitude of 20 meters, and the aircraft, going into a descent, crashed into the ground. The crew was killed.

Research showed that the cause of the roll in the roundout was the asymmetrical setting of the trailing-edge flaps due to the fatigue failure of the jaw of the retraction hydraulic cylinder and the extension of the middle section of the right trailing-edge flaps. Instances of the failure of the jaws of the root sections of the trailing-edge flaps in flight had been noted on MiG-23 type aircraft before. But they had not been accompanied by such grave consequences as in this case. The pilots had successfully countered the forces from the asymmetrical status of the trailing-edge flaps. This is explained by the fact that the magnitude of the asymmetry between the left and the right flaps (the "scissors) in the first and second instances of failure were different. Whereas the middle hydraulic cylinder takes about 50 percent of all of the air load on the flaps, the root and end ones divide the remaining load roughly equally between themselves.

The dependence of the angle of setting of the flaps on the flight speed in normal operation of all three hydraulic cylinders (a) and with the failure of operability of the middle one (b) are presented in the figure.




Calculations showed that the loss of altitude in roundout at a speed of 300 km/hr and $n_u$ = 1.1—1.3 (with flaps fully extended) is roughly one meter. When the flaps are retracted at that speed the angle of descent increases and the vertical velocity grows (from 4 to 8.5 m/sec). The loss of altitude in roundout increases to four meters therein, which must be remembered by the flight crew.

An assessment of the controllability of the aircraft in the event of landing with an asymmetrical flap setting (if the jaw of the middle hydraulic cylinder has failed) for various flight parameters is presented in the table.

| Flight speed, km/hr | Aircraft angle of attack with regard for divergence of flaps, degrees | Divergence of flaps, degrees | Deflection of stick to counter forces from divergence, percent | Angle of attack of aircraft requiring full deviation of stick to counter forces from divergence, degrees |
|---|---|---|---|---|
| 260 | 12 | 30 | 100 | 12.5 |
| 280 | 10 | 30 | 88 | 12.5 |
| 300 | 6.5 | 23 | 88 | 12.5 |
| 350 | 4 | 14 | 81 | 12.0 |

The data presented in the table testify to the fact that at flight speeds of 280-350 km/hr, deflections of the control stick are sufficient to counter the roll forces from the divergence up to angles of attack of 12.5-12.0°. The setting of the stick is less than 90 percent therein, and virtually 100 percent at a speed of 260 km/hr.

Returning to the incident that was described, we note that the separation of the MiG-23UB aircraft from the runway occurred at a speed of 290 km/hr with an angle of attack of 9.6°. The angle of roll later increased at a rate of 5—15 degrees/sec with the gain in altitude, and the angle of attack in the third second after separation from the runway was 10.6°, and then started to increase and reached 14—15°.

The deflection of the stick was thus sufficient to counter the roll in the gain of altitude over the first three seconds. Countering the developing roll became impossible with the increase in the angle of attack, which is what led to the crash.

The replacement of the jaws of the hydraulic cylinders with reinforced ones is currently underway in the line units and at repair facilities. The likelihood of a similar tragic situation arising will be reduced.



## History of Development of Fighter/Bomber Tactics

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[Article by Candidate of Military Sciences Colonel (Retired) Ye. Lavrentyev under the rubric "Air Forces Tactics: History of Development": "Fighter/Bombers"; conclusion—for beginning see No. 1]

[Text] The tactics of fighter/bomber aviation in the Soviet Air Forces were perfected with a regard for the latest

achievements in the realm of military science and aviation hardware. The experience of combat operations by strike aviation in local wars was studied and analyzed, although it must be noted that the information on this issue was not always sufficiently complete (especially on methods of attack, types of maneuvers, the parameters of their execution and the types of weaponry employed).

It is noteworthy that armed conflicts, for example between the United Arab Republic (UAR) and Israel or India and Pakistan, introduced nothing that was fundamentally new into the tactics of our fighter/bomber aviation, since the Arab and Indian pilots employed tactical methods that had already long been mastered by our pilots and did not always employ them, it must be said, in a competent or skilled manner when carrying out strikes against ground targets. This sometimes led to a reduction in the effectiveness of air strikes and excessive losses from enemy PVO [air defenses].

Tactical methods analogous to those practiced by fighter/bomber pilots in the Soviet Air Forces were employed in a number of cases in the operations of strike aircraft of the United States in Vietnam and of the Israeli Air Force in the war against the UAR—approach to the target at the lowest possible altitude, execution of the strike on the go by solitary crews and pairs from horizontal flight with H = 150—200 meters, attack from $\theta_{dive}$ of 10—45° after execution of a steep climb or chandelle, departure from the target with a descent to the lowest possible altitude or gain in altitude to H = 3,000—4,000 meters. American and Israeli pilots, in addition to this, made widespread use of some tactical methods that were new to us at the time—the execution of a simultaneous strike against one and the same target from various directions, the destruction of enemy radar by self-homing air-to-radar missiles, the execution of decoy (diversionary) operations with the simultaneous use of ECM gear, bombing from horizontal flight with H = 4,000—6,000 meters, attacks from $\theta_{dive}$ = 30—60° with an altitude of entry into the dive of 4,000—8,000 meters and pullout from its at H = 2,000—4,000 meters (outside the area of effective fire from enemy low-altitude air-defense systems), and the execution of maneuvers for the evasion of SAMs launched against the aircraft.

All of these tactical innovations, with the exception of attacks executed from high altitudes (their use by the crews of MiG-17 and Su-7B aircraft that did not have the appropriate airborne sighting equipment and armaments for it would simply have been ineffective), were immediately put into service by our fighter/bombers. They began to make simultaneous strikes against one or several closely positioned targets from various directions, to employ diversionary operations when supporting strike groups and to execute anti-missile and anti-fighter maneuvering.

Methods and tactical devices for operations from medium and high altitudes began to be widely adopted (the limited tactical radius of the strike aircraft when flying at low or very low altitudes was also taken into account therein) to the extent of improvements in the organization of enemy PVO and the increased effectiveness of his field defenses (small-caliber anti-aircraft artillery, low-altitude SAM systems).

The crews of fighter/bomber aviation, in order to surmount the opposition of Hawk and Nike-Hercules SAM systems at those altitudes, thus practiced the "cobra" maneuver, which was a horizontal S-turn that is executed by a pair, flight or squadron with periodic changes of flight direction of 90° relative to the line of the heading and the transition of the crews or the wing aircraft or pairs to the opposite bearing in each turn (it is also an effective anti-fighter maneuver).

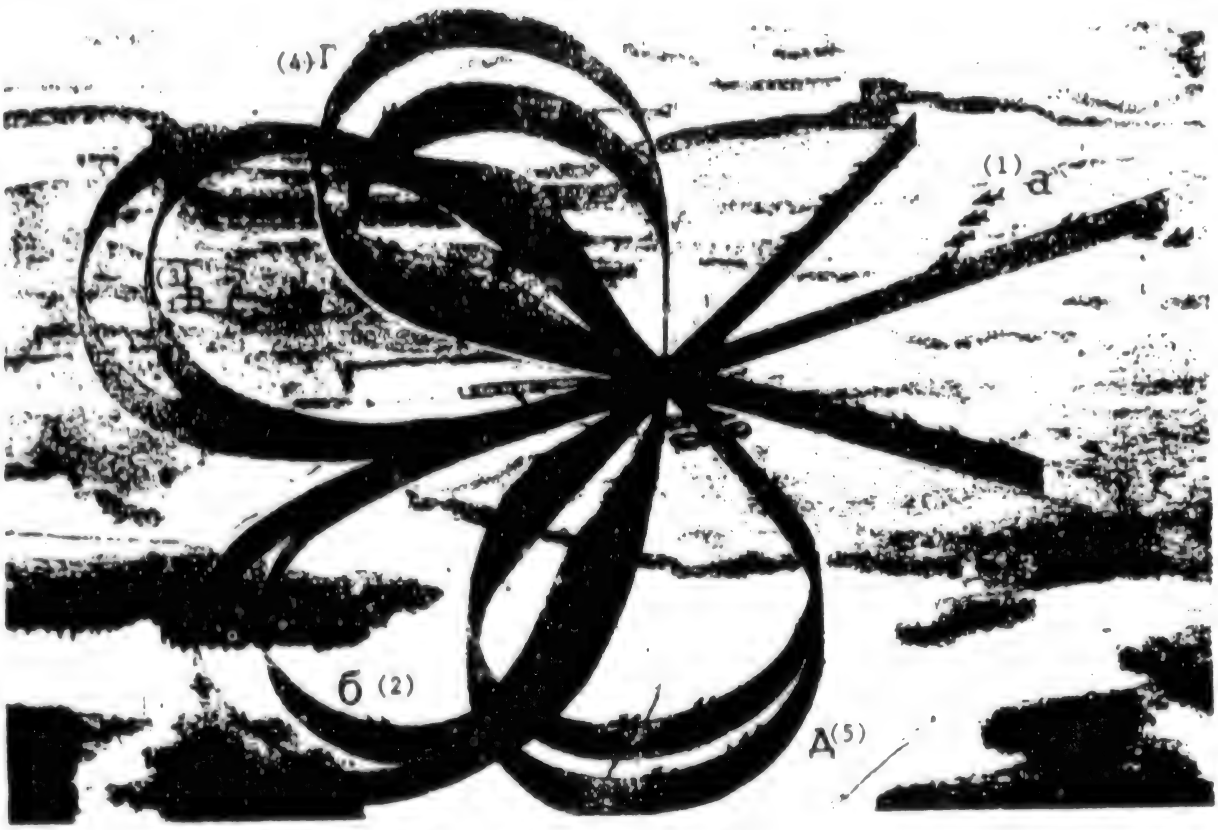
Various types of maneuvers to evade SAMs or air-to-air missiles that had been launched against the aircraft along with maneuvers against anti-aircraft artillery were also practiced, individual (airborne jamming units, antiradar missiles and cannon shells) and group (jamming helicopters and aircraft) means of EW were employed and utilized accordingly and strikes were carried out against opposing air defenses.

The pilots of fighter/bomber aviation began using new maneuvers of the "lasso" type (see figure) in operations against ground or naval targets starting in 1972. They provide for the shortest period of time after the completion of the first attack for the execution of repeat attacks from various directions with the simultaneous break-up of the group into solitary crews or pairs, which markedly reduces the likelihood of the defeat of the aircraft by target air defenses and, at the same time, increases the effectiveness of the strike. This maneuver can be executed in the form of a chandelle ("combat-lasso") as well as in the combination of a turn at the lowest possible altitude to a nominal angle with a subsequent steep climb, for which the end of execution is the moment of the entry of the aircraft or pair into a dive at the target ("lasso-10" and "lasso-20," distinguished by the duration of the flight from the target to the start of execution of the maneuver).

The third-generation Su-17 and MiG-27 aircraft with variable-geometry wings began arriving in service with fighter/bomber aviation in the first half of the 1970s, making it possible to obtain high indicators for maneuverability across the entire operating spectrum of altitudes and speeds. An increase in the top flight speed at the ground compared to the Su-7B type aircraft, for instance, made it possible to reduce the time from the moment of receipt of the combat assignment to the execution of the strike (this is especially important in the fulfillment of requirements for the immediate destruction or suppression of newly revealed mobile ground targets). The tactical radius of the new craft in flights with ordnance loads almost doubled through the installation of more economical engines and the use of large-capacity external fuel tanks. Thanks to this the opportunity was obtained of executing strikes against enemy targets located at operational depth. The overall quantity of enemy targets assigned to the fighter/bomber crews to strike in the front-line zone increased by approximately 30—40 percent.

The ordnance load of the aircraft increased significantly, while the arsenal of weaponry they employed was supplemented with air-to-surface (with radio-command, laser and television homing systems), air-to-air and air-to-radar guided missiles, guided aerial bombs, rockets and bombs of increased might for various purposes, and improved artillery weaponry (multiple-barrel cannon with high rates of fire).

The air-to-surface class missiles, for example, make it possible in a number of cases to attack a target without entry (or with an abbreviated entry) of the aircraft into the lethal zone of low-level anti-aircraft defenses (missiles with laser




**Execution of strike by two fighter/bomber squadrons against ground target**

**Key:**
**1—first attack by flights in horizontal flight; 2—second attack by first flight from dive using "lasso-10" maneuver; 3—second attack by second flight by pairs from dive using "lasso-20" maneuver; 4, 5—third attacks by flights using solitary crews using the "lasso-combat" maneuver**

homing heads can be employed successfully with target illumination from the ground as well as the air), while the air-to-air missiles provide for the more effective defeat of enemy aircraft in aerial battles and the air-to-radar missiles allow strikes in both day and night under any weather conditions without entry into the lethal zone of all types of air-defense systems without exception. The use of aerial assault bombs and movable cannon installations make it possible to attack a target from the lowest possible altitude and at high speed, which ensures the concealment of the approach of the aircraft to the strike target and its low vulnerability to PVO fire.

The fitting of fighter/bombers with navigational and bomb-sight systems (PRNK) has substantially raised the precision of aerial navigation and the use of aerial weapons systems (ASP) while providing for the high likelihood of the crew reaching the target and executing an effective attack on the go, which is especially important when flying deep into enemy territory at large distances, very low altitude and high speed.

The automatic (when the pilot only monitors the flight mode) approach of the aircraft to the strike targets and dropping of bombs (so-called navigational bombing, chiefly against area targets) in day or night under any weather conditions, including in or behind clouds, as well as the dropping of bombs when pulling out of a dive, have become possible with the aid of the PRNKs, making it possible to employ several types of ASP simultaneously in one attack.

The use of PRNKs has furthermore freed the crew of the necessity of continuously performing visual orientations during flight, thereby giving them the opportunity to focus all of their attention on the execution of anti-missile, anti-air-defense or anti-fighter maneuvers, the preparation of the aircraft armaments before the start of the attack and the use of aerial EW systems. And this in turn allows the fliers to make prompt determination of the moment of illumination of their aircraft by the ground or aerial radars of enemy SAM systems or interceptors respectively, single out the most dangerous among them (its azimuth and range, speed of convergence with it and nature of the illumination) and engage in active and passive jamming.

It cannot fail to be noted at the same time, however, that the overall number of operations (various checks, switches, settings) performed by the pilot in the aircraft cockpit when changing the method of attack or converting from one type of weaponry to another has increased considerably with the adoption of automation in the process of combat application of ASP.

The required force details for the destruction or suppression of enemy ground or naval targets has decreased substantially in general through the increases in ordnance loads of third-generation aircraft, the use of more powerful and diverse weapons systems and the improved sighting systems, which has made it possible for contemporary fighter/bombers to wage combat operations in smaller groups than those with Su-7B or MiG-17 type aircraft (the combat potential of the new aircraft has more than doubled). This, however, in no way rules out the expediency, in a number of cases, of their execution of simultaneous strikes, for instance against battalions of operational-tactical missiles or SAMs, enemy airfields, his troops and combat vehicles on concentration areas or other targets using conventional weaponry as part of large groups (squadrons and regiments).

An important role has currently come to be relegated to the destruction of the ground elements of enemy reconnaissance/strike systems and his aircraft, helicopters and drones in the air with the adoption of a defensive military doctrine by our state.

The crews of modern fighter/bombers in operations against ground or naval targets utilize many of the methods of combat operations and tactical devices (attacks, maneuvers) that were employed before using Su-7B aircraft, with only the altitude, flight speed, angles of dive and pull-up and range of weapons utilization altered somewhat. They execute strikes against ground or naval targets within a range of altitudes from 50 to 11,000 meters and speeds of 600 to 1,250 km/hr. Conventional and guided bombs, external cannon, air-to-surface and air-to-radar missiles and special ordnance are employed from horizontal flight: conventional and guided bombs, external and built-in cannon and air-to-surface missiles are used from a dive (with simple and complex types of maneuvers with $\theta_{dive} = 10$—$40°$); and, one-time bomb clusters and bundles from pitch-up (with $\theta_{pitch}$ of 10—20°) and special ordnance (with $\theta_{pitch} = 10$—$115°$). The technique for executing attacks from a dive at night against targets illuminated from the air has also been altered somewhat: they have begun to be performed from above, rather than below, the aerial illumination bombs.

The opportunity has appeared in a number of cases, when planning combat operations, of dispensing with the allocation of several groups for the support of the combat flight (destruction of target PVO, jamming) due to the use of guided weapons by fighter/bomber crews (first and foremost the air-to-radar guided missiles) and effective means of EW. The battle formations have become more stretched out in depth than they used to be therein.

Another fact should also be noted. A small quantity of fighter aircraft that, entirely naturally, possessed better combat capabilities than the "pure" fighter/bombers for the destruction of airborne targets through the presence of radar sights and air-to-air missiles on board has also been in service with fighter/bomber aviation for the last two decades. It must be said, however, that they were insufficiently adapted, bluntly speaking, for operations against ground or naval targets in view of the presence of less powerful armaments and the lack of the appropriate sighting equipment.

The organization of command and control of the units and subunits of fighter/bomber aviation with the ground and airborne command posts has been improved continuously in the course of its development based on the widespread utilization of automated systems, and more flexible forms for organizing its interaction with other types of aviation and branches of the armed forces in the course of waging joint combat operations have been sought out and practiced. The experience that was obtained by the fighter/bombers when performing their missions under the mountain and desert conditions of Afghan terrain was invaluable on this question.

As for the prospects of fighter/bomber aviation, they depend first and foremost on the possible changes in the means, methods and conditions for the waging of armed struggle. The acute necessity of reducing the "tying" of fighter/bomber aircraft to base airfields, for example, has arisen in connection with the appearance of new and effective types of enemy weapons (to rule out large losses of people and materiel when the airfields are struck). The creation of aircraft with short or vertical takeoff and landing that are able to be based on unprepared airfields or sites with restricted dimensions is thus most likely in the future for this branch of aviation.

The considerable scope and continuous nature of the execution of modern combat operations, constant improvements in enemy PVO systems and the importance of the timely and reliable striking of small and mobile enemy targets (especially means of nuclear attack and ground elements of reconnaissance/strike systems) in tactical and operational depth pre-ordain the waging of effective combat operations by fighter/bombers under any weather conditions, require an increase in the tactical radius of the fighter/bomber aircraft and their outfitting with more modern bombsight, navigational and piloting equipment, armaments and EW gear, the maximum automation of the processes for surmounting PVO and the execution of maneuvers for reaching a previously assigned (or newly detected) target and attacking it, and increased range, accuracy and effectiveness in the employment of ASP, as well as its maximum possible standardization.

The changes that are transpiring in the nature and conditions for the waging of modern combat operations will inevitably lead to the necessity of a further rise in the fighting ability of the units and subunits of fighter/bomber aviation and the development of new methods and tactical devices for surmounting PVO and defeating enemy targets.

Ground-attack aviation has currently returned to the field of battle, displacing fighter/bomber aviation from the performance of the functions of direct air support for the troops. Both fighter/bomber and fighter aviation, on the other hand, are equipped with aircraft whose combat capabilities are quite close. Both the one and the other perform tasks that are very similar in nature (the difference consisting only of the level of training of their crews for operations against ground and aerial targets). It is thus not ruled out that a convergence of those two branches of aviation could occur in the future, and a multirole aircraft could enter service with it that is adapted to a sufficient extent to the destruction of both ground or naval and of airborne targets at tactical and operational depth. And that will undoubtedly require improvements in the process of training the flight personnel for combat operations.

## Evasive Maneuver Against NATO SAM Systems Evaluated

*92UM1254F Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 92 (signed to press 23 Jan 92) p 16*

[Article by Candidate of Military Sciences Lieutenant-Colonel B. Fedulov under the rubric "Tactics in Combat Training": "One-on-One Combat With a SAM"]

[Text] Fighting against enemy PVO [air-defense] systems under contemporary conditions for waging combat operations poses a difficult problem for aviation. The conflict in the Persian Gulf region confirmed this once again; despite the use of the latest models of aircraft and means of EW, tactical techniques for surmounting the Iraqi PVO were based, as a rule, on skirting the lethal zones of the air-defense missile [SAM] systems according to their ranges and altitudes. The requirement to include a group of aircraft for PVO suppression in the overall battle formation arose when it was necessary to make air strikes against well-protected targets, which increased considerably the expenditure of force for the performance of the combat missions.

The most effective means of destroying PVO systems is considered to be operations by strike aircraft immediately in the lethal zones of the SAM systems. This could be achieved, however, only with the observance of such an important condition as the invulnerability of the aircraft. One of the principal ways of achieving it was the execution of anti-missile maneuvers, taking into account—aside from other factors—the dynamic errors in the homing of the air-defense guided missiles on the targets.

It is well known that aircraft maneuvering leads to a sharp increase in the error signal at the input to the SAM control system, for the elimination of which a certain amount of time is required (response time). The total homing error moreover depends on the G-forces acting on the missile, the response time of its control circuitry, the speed of convergence of the SAM with the aircraft and the distance between them, as well as the maneuvering properties of the aircraft.

Calculations show that it would be most efficient to initiate the maneuver a few seconds before the encounter with the missile, especially when it is launched from the forward hemisphere, but that is too risky. It must furthermore be taken into account that the launch of two or more missiles against a single target at intervals commensurate with the response time of their control circuitry or the execution of a certain maneuver by an airborne enemy is possible in order to increase the effectiveness of fire. It is thus expedient to maneuver over the course of the entire flight in the SAM lethal zone if it is not possible to establish with high certainty the moment of launch of the SAM, either visually or with the aid of on-board equipment.

A mathematical model of a one-on-one situation between a fighter/bomber and a SAM for ranges of 0 to 15 kilometers between them was developed and run on a computer in order to determine the parameters of such maneuvering and assess the effectiveness of its use. This made it possible to compute the most expedient maneuvers for the aircraft that would provide a high probability of the instantaneous miss of the missile and the overcoming of SAM resistance. One such maneuver is the "fast S-turn," the parameters of which are shown in the table.

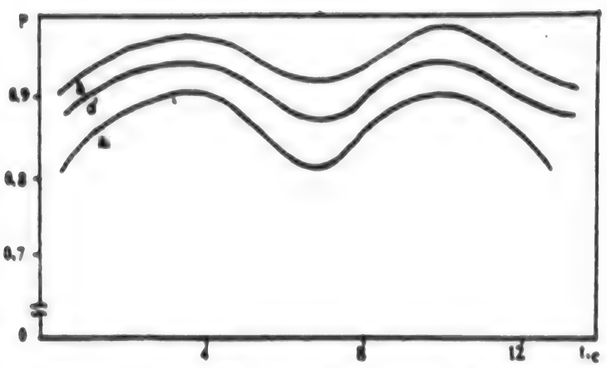
| Roll in execution of maneuver, seconds | Half-period of maneuver, seconds | Angle of deviation from heading, degrees | Likelihood of surmounting of SAM opposition |
|---|---|---|---|
| 60 | 3—5 | 15 | 0.76 |
| 70 | 4—7 | 35 | 0.90 |
| 75 | 5—9 | 50 | 0.98 |

The maneuver consists of the following: the pilot executes a chandelle at a stipulated angle with an assigned degree of roll, after which he changes it to the opposite at a rate of 90—120 degrees/second. At a roll of 70°, for example, its shift must be started after the turn from the assigned heading line of 35°. The selected direction of flight is maintained therein, at an air-defense missile system, for instance.

The miss of a missile against an airborne target executing this maneuver occurs because the SAM control circuitry is not able to eliminate quickly the homing error that arises in view of the constantly changing trajectory of aircraft movement.

The figure shows the nature of the effects of the principal disruptive factors on the likelihood of the aircraft's evasion of the SAMs that are in service with the NATO countries today (the maneuver is executed at medium altitudes with normal G-forces at $n_u = 3$, changes in the direction of the trajectory of movement every 6 seconds and speed of resetting roll of 90 degrees/second). The execution of the "fast S-turn," as can be seen, provides for the high survivability of the crew of the strike aircraft in a confrontation with an enemy SAM.

There is no doubt that the competent application of the new tactical devices based on the execution of the proposed maneuver, combined with the use of individual and group ECM measures and others supporting the combat sortie, will facilitate the successful surmounting of the PVO by the crews of the frontal aviation and a rise in striking power.



**Nature of the change in the likelihood of SAM miss against airborne target depending on the time remaining until the assume moment of encounter:**

Key:
*a*—with regard only for execution of "fast S-turn" maneuver;
*b and c*—resulting value with a regard for instantaneous miss of SAM and fluctuation errors of homing respectively.

## Analysis of Effects of Visual Distortions on Aircraft Accidents

*92UM1254G Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 92 (signed to press 23 Jan 92) pp 17, 27*

[Article by Doctor of Medical Sciences Colonel of the Medical Service (Reserve) V. Roslyakov and Candidate of Medical Sciences Major of the Medical Service I. Ovechkin under the rubric "To the Pilot on Psychology": "The Vision Factor"]

[Text] The improvement of aviation hardware and expansion of the spectrum of its combat capabilities has been accompanied by increased complexity in the professional activity of the person. He frequently has to work under the far from simple conditions connected with restricted capabilities of the senses, a so-called manifestation of the human factor. This especially affects sight, due to changes in the conditions for the perception of visual information in connection with the adoption of head-up systems for the depiction of information (SOI), the increased effects of vibrations and prolonged G-forces on the visual analyzer and the effects of design imperfections of the workstation, including the worsened view from the cockpit, and distortions in the visibility of surrounding objects through the cockpit glass and the special protective gear of the pilot.

This frequently leads, with the restricted capabilities of the visual analyzer, to a decrease in the reliability of the vision function of the pilot, as the result of which various types of perception and illusion problems arise.

A certain lack of conformity between the standard requirements for the lighting environment in aircraft cockpits and the properties of the on-board systems for illumination, signals and SOI currently still exists. Those properties include the uneven nature of illumination, the presence of light sources that create shine, excessive illumination at night and insufficient illumination of the instrument equipment during the day and the like.

These drawbacks lead to worsened visibility of individual inscriptions and symbols, fatigue of the eyes and, as a consequence, errors in evaluating information from the instruments.

One problem area in visual perception is the blinding factor as the result of sharp changes in the level of illumination in the external environment and in the aircraft cockpit. A logical and natural physiological phenomenon of the temporary loss of sight arises in the pilot through sun in the eyes, exposure to the beam of a searchlight or the burst of an explosion at night and the like, and he is virtually completely disconnected from the process of piloting with the attendant consequences

The quality of visual observations of objects outside the cockpit depends to a significant extent on the design features of the pilot's workstation, the view from the cockpit and the optical parameters of its canopy. Their worsening leads to a reduction in the possibilities for visual perception, the appearance of double images, disruptions in color transmission and the like. The significant dimensions of the "blind spots" of the cockpit—the areas of it that cannot be seen through—force the pilot to change his basic work position, be distracted from piloting and make spatial orientation in flight more difficult.

Flight at low or maximally low altitudes is considered to be unfavorable from a safety standpoint when the visual assessment of the distance to the ground and visual observation of points of reference on the ground that are moving at various angular velocities across a large spectrum of brightness and contrast features have the leading significance. Errors in determining the distance to the ground depending on the altitude and flight speed are the most typical under those conditions.

It should also be taken into account that the age of the pilot has a marked effect on the state of visual functions. The optimal level of those functions is noted in individuals from 20 to 30 years of age. An average lessening of visual acuity of 20—30 percent is subsequently observed. Fatigue phenomena and even insignificant changes in the individual's customary working conditions lead to a further additional decline in the effectiveness of visual functions and facilitate the appearance of errors and perceptual illusions. Unfavorable flight factors, especially prolonged G-forces and vibrations with insufficient effectiveness of protective means, for example, have a substantial effect on perceptual acuity, sensitivity to contrast, color sensation and night vision. His acuity could drop to 0.7—0.5 even at normal G-forces of 4—5.

Optical illusions are usually understood to be the erroneous perception of actual objects and phenomena that is difficult to correct by a visual analyzer that is functioning normally overall. The principal conditions for their appearance and manifestation in flight are presented in the table.

| Causes of the appearance of optical illusions | Conditions of manifestation | Nature of optical illusions |
|---|---|---|
| Shortage of visual information—decreased object content of space | disoriented space (at high altitude) | feeling of "immobility" in space |
| | small number of informational signs for evaluation of distance in flight over water or snow-covered surface | incorrect visual assessment of distance from the ground |
| | prolonged fixation on lights in front of flying aircraft | illusory movement of immobile light source |
| Changes in nature of dynamic properties of objects being observed | rapid changes in visual situation not characteristic of ground conditions | erroneous perception of "increase" in speed to the extent of convergence with the ground and its "reduction" to the extent of gains in altitude |
| | | overestimation of the proximity of the ground when descending from high altitude |
| | | "swelling" or "melting" of approaching or receding aircraft; illusion of "blind space" |
| Incorrect assessment and transfer of skill in ground orientation to flight | varying contrast of ground objects, varying brightness of objects being observed under nighttime conditions | incorrect visual assessment of altitude of flight and distance from objects |
| Optical distortions | flight on starry night over water surface and in clouds | illusion of "star encirclement" |
| | flight over mountainous terrain | *"delibab"* illusion—distortion of perception (doubling) of runway |
| | change in refractivity properties of air environment | illusion of rising horizon line in morning hours |

The appearance of distortions in perception could also entail disruptions of visual information on the situation outside the cockpit, especially if the flight is taking place outside of visibility of the ground or the natural hor: on.

It is officially felt that the principal causes of accidents associated with the factor of the individual are pilot errors conditioned by the distraction of attention, mistakes in reading information from the instruments, excessive self-confidence and the like. These phenomena could also, in a number of cases, be a consequence of the appearance of distortions in visual perception, and there can be no discussion in that case of the direct blame of the crew. Military pilot 2nd class Senior Lieutenant I. Sidorenko, for example, committed a gross landing of the aircraft short of the runway, as the result of which it was damaged.

An investigation of that accident showed that the pilot, not assessing the actual flight speed in descent, cut the engine RPM too soon. The official cause of the accident was an error in piloting technique. A deeper investigation of this incident, however, established that this mistake was caused under those weather conditions by the illusion of an increase in the approach speed to the extent of the convergence of the aircraft with the ground, which provoked the decision to cut the engine revolutions ahead of time.

One method of preventing visual disorientation and persistent optical illusions is constant psycho-physiological correction of one's sensations according to instrument readings and commands from the ground, weather conditions and other conditions for the performance of the flight regardless of the complexity of the assignment. This is also facilitated by an understanding by flight personnel of the essence of manifestations of this phenomenon in flight. A number of most simple preventive measures could also be of some help in overcoming it, such as fixing the eyes on immobile objects in the cockpit, changing posture and doing physical drills, among other things.

In conclusion I would like to note that according to the data of American research, about 11 percent of all erroneous actions by flight personnel during landings on aircraft carriers are conditioned by the appearance of optical illusions among the pilots. No interconnection of the erroneous actions of flight personnel, accidents and crashes with disruptions of visual perception has been revealed according to our own official statistics. These data, based on a host of experimental flight and laboratory research, testify to the fact that the physiological capabilities of members of the flight crew do not permit the quality performance of the visual task—*i.e.*, His Majesty the human factor comes into its own—under certain flight conditions. The erroneous actions in flight are namely a consequence of it, and this requires careful and comprehensive analysis of the conditions under which an accident occurred before talking about the degree of personal blame for the pilot.



## Practical Aerodynamics Seen Lacking in Helicopter Pilot Training

*92UM1254H Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 92 (signed to press 23 Jan 92) pp 20-21*

[Article by Military Pilot 1st Class Colonel (Reserve) A. Yurchenko under the rubric "From LIfe at the Higher Educational Institutions": "Will Aerodynamics Become Practical?"]

[Text] I cannot imagine an instructor pilot who does not want the cadets in his flight group to have an excellent understanding of questions of practical aerodynamics. No

one need be convinced that the ability to substantiate piloting technique and one's actions when correcting deviations and in special cases in flight, the knowledge of everything that a pilot could encounter in the air, are conditions for success in the attainment of the dream to become a military pilot, as well as professional longevity in the future, for the trainees at a VVAUL [higher military aviation flight school].

But something else has also been proven—a flier who does not study how to apply practical aerodynamics correctly in his work right in the first courses at the school will not be able to utilize them in the future, either in the training regiment or in the line unit. This substantial drawback could remain with the pilot over his whole "pilot's" life and doom him, in essence, to the role of poor tradesman knowing only how to "tug" on the stick. He will grow in his position, but aerodynamics and flights will have nothing in common with each other for such a commander. That is what actually does happen in real life.

And could it be achieved that aerodynamics[1] really would become practical at the flight schools of the Air Forces, including the helicopter schools? In order to answer that question we must analyze, at a minimum, three areas that are accessible to solution within the framework of the Air Forces: what is the cadet being taught today, that is, the aerodynamic curriculum and texts, how is he being taught and using what training base and, finally, who is doing the teaching?

**What is the Cadet Being Taught?**

During the first year of training more than 70 hours are devoted to the general course in aerodynamics and the dynamics of flight. The cadets have to memorize a host of formulas, graphs and diagrams, make calculations in the process of lab work etc. But they make virtually no use of all of this when preparing for flights and in the process of performing them. The upperclassmen who have already mastered the combat aircraft, moreover, "exchange experience" with the underclassmen and quickly convince them that "What you learn about aerodynamics in the first year you don't need."

One also cannot fail to take into account that the level of general educational preparation of the entrants is declining continuously with each new group of matriculants to the schools in recent years; there are fewer and fewer Air Forces patriots among them, and the meetings of the flight commanders (senior officers) with the first-year cadets are more and more rare. The closest officers to the trainees—the platoon or company commanders—are not all, and not always, very high on issues of general and special training. So it obtains that there is no one other than the instructor to help the cadet single out what is most important in the aviation sciences, to explain and instill the significance of the basic tenets of it for the future pilot. But since, from the point of view of the trainee, the instructor is supposed to "instill," all of the efforts of the teacher are perceived as not very much.

The fact that a youth who has landed under conditions of living and activity that are new to him, with the great saturation of the program with general educational disciplines, has the same attitude toward the study of aerodynamics as toward the other subjects, since they are all important to him, is also of no small importance herein. The special knowledge among the overwhelming majority of the cadets at this stage of training will thus be weak, since they are studying aerodynamics just so as not to get a D.

This mistake has an immediate effect in the second year in the study of the theory of helicopter flight—the material that was passed over must be studied afresh; otherwise it is impossible to proceed normally through the program. Since the theory of flight is complex and the number of hours relegated to it is limited, but all questions of the program should be studied (even with weak knowledge of the cadets in both the general and the special sciences), there ends up being even less time for studying the techniques for the execution of specific elements of flight and aerobatic maneuvers due to the repeating of the material. The instructor has to economize right in the things that are most essential to the process of flight work. The program moreover does not envisage analysis of the mistakes made by cadets, especially in the initial stages of training, and the most typical deviations and their theoretical substantiation.

A profound knowledge of all of the special cases in flight as set forth (or not set forth) in the instructions to the crew is also not envisaged by the start of flights (due to the intensiveness of the program), as if this or that non-standard situation will wait until the cadet has genuinely studied it in later—the third or fourth—years. The same could also be said about substantiating various operating restrictions, as well as the maximum flight modes.

Upon completion of theoretical training (in the first and second years), the cadets masters many formulas and memorizes a large quantity of graphs and diagrams. This is fine, but it would be better still if he knew which formulas, graphs and diagrams he will need constantly, which he will encounter occasionally and which he should only be familiar with.

Can it be normal, for example, when the future pilot knows the outcome of the formula for the thrust of a main rotor but does not understand how the forces change in flight and what "behavior" should be expected from the helicopter therein? The situation is further aggravated by the fact that there is still no textbook for helicopters that is accessible to the cadet and easy to comprehend on the theory of flight. They have all been written by those who have not had flight education or have themselves forgotten when they themselves last flew. If one adds to this the fact that only a handful of the cadets know how to work independently with textbooks and take notes in classes, the overall picture of the study of aerodynamics in the first and second years becomes understandable.

One can thus draw the following conclusions: the curriculum for the first year must be composed in such a way that all the theoretical tenets of aerodynamics and the dynamics of flight of a helicopter have a practical thrust, and instructors and instructor pilots must be involved in this goal; the cadet should complete a full program of practical aerodynamics of the helicopter in the second year, so that he can later perfect his knowledge apropos of increasingly complex types of flights and new types of aircraft; and, a new textbook is

needed on practical aerodynamics, written by pilots with the involvement of engineers and not the other way around.

**How is the Cadet Being Taught?**

The priority in the instruction process in every department is currently given only to one's own discipline; there is virtually no regard for what, when and how other subjects are being taught, even though on a structural-logic basis the sequence of completion of all academic topics has been made inherently correct. And that means there is no comprehensive instruction, and no directives, instructions and interdepartmental conferences will be able to rectify matters. It is long since time to convert to a system of "orders for knowledge," where the general educational departments work "on order" for those training subdivisions that are immediately connected with the flight training of the cadet. Only then will they all have a practical thrust toward flight activity.

The question of uniting a series of allied departments and selecting instructors for them who know flight work well is far from an idle one today. That would only be in the spirit of the times with the cutbacks in the armed forces. And we have such examples in our history. A department (cycle) existed in the first years after the war where aerodynamics, helicopter and engine design, radio equipment and instruments were studied in cadet training. It was a unified center for the training of special disciplines that were felt important for future pilots, where redundancy was eliminated in instruction and the teaching time was utilized efficiently.

Could that experience then be transferred and used in today's training process? The quality of training and indoctrination, I think, would be improved. The resources freed up could be directed toward developing the training base and improving the pay for the individual labor of the instructors.

One very often hears that simulators that imitate flight are needed for a practical thrust in the study of any discipline, and practical aerodynamics in particular. The lack of them is a great misfortune for the helicopter schools. But who or what is keeping the VVAULs from making simulator-jigs with the aid of that very same aerodynamics department that could be controlled by the same helicopter controls or by radio, remote control, equipped with "blinking lights" and the like? And helicopter cockpits for the classrooms, for the simulator complex? Why not saturate them with electronics and, using all of these teaching aids together, teach the cadet practical aerodynamics both on concrete questions and on individual topics, visibly imitating the behavior of the aircraft in space? With this approach the future pilot will have an interest in studying the material under the program (within the limits of what is possible at that level of training), and this will allow him to learn to combine theory with practice.

I would also like to direct attention to another substantial mistake in the training of cadets—the process of teaching them aerodynamics and its practical application could be losing out due to the lack of a well thought-out system of interaction of instructors in the department with the flight personnel of the training regiments.

The overall improvement of the quality of training requires:

—reducing the quantity of departments and bringing their activity closer to the specific tasks that are being resolved at the flight schools;

—having simulator-jigs manufactured at the VVAULs and supplied in centralized fashion by industry that make it possible to model flight in a helicopter; and

—providing for constant interaction between instructors and flight personnel in the training regiments.

**Who is Teaching the Cadets?**

He who is either flying regularly himself—or who used to fly—and has a high level of training in various types of flights, is inclined to instructional work and wants to be a teacher should be teaching the theory of how flights should be performed.

But is it always just that way in practice? The departments are frequently still staffed with cadres who bring only harm to the teaching process with their "competence" and attitude toward the work. Can a situation really be considered normal where most of the instructors in the special departments, including aerodynamics, were not pilots? They are not regarded as professionals by the cadets, since they cannot know all of the nuances in the work of the pilot. I do not think that such teachers have a great desire to tell the cadets how to pilot a helicopter, or conduct classes "at the start" during the period of flight training.

Something should be said in particular about the dissertations of instructors in the departments of aerodynamics and flight dynamics. They are, as a rule, connected with topics that are far from their possible application in the process of teaching cadet pilots. I am sure that there is not a single work on improving the connection of theory and practice in the professional training at the VVAULs, such as, for example, "Researching the Effects of a Knowledge of Practical Aerodynamics on the Challenge Program in the First-Year Training of Cadets." A teacher who did not fly is scarcely able to perform such research, since it is necessary to analyze and summarize not only the data presented to him, but also his own, personal data acquired in the process of flying with cadets.

The instructor pilot in turn cannot work on a dissertation topic in his field, because such topics are not ordered from the higher educational institutions of the Air Forces. They are not accepted for graduate study on such topics either at the Air Forces Academy imeni Yu.A. Gagarin or at the Air Forces Engineering Academy imeni N.Ye. Zhukovskiy. And it turns out that dissertations are done, but their results cannot be used at the flight school to improve the teaching process.

It is vexing that newly assigned instructors who are former instructor pilots, as a rule, take the same beaten pedagogical path and bring neither new techniques nor new teaching methods to the educational process, since the instructional technique remains as before. Substantial changes have not occurred in the direction of a practical thrust in improving the physical plant for teaching either.

The conclusions are as follows:

—a pilot who has flown (or is flying) a helicopter of the given type and who has not only a great deal of flight and life experience, but also an inclination toward instructional work, should be teaching the cadet practical aerodynamics;

—the topics of dissertations must be changed and supplemented for the purpose of improving the teaching process; and

—the possibility of utilizing instructor pilots of 45—50 years of age who will be discharged under the cutbacks in the armed forces should be considered. The number of officers in the departments should what is required under the mobilization plan.

I would add in conclusion that the issues of improving the quality of cadet training in practical aerodynamics raised in the article pertain, if the extant situation is analyzed, not only to that science but to other disciplines as well.

Everyone will have to be seriously occupied with improving the teaching process at the flight schools sooner or later. And it would be better to be occupied with it sooner, so that we do not lag behind other countries in questions of pilot training.

**Footnote**

1. This term will hereinafter be understood to mean practical aerodynamics—the applied portion of aerodynamics, the dynamics of flight, the theory of engines and control systems, the knowledge of which makes it possible to consciously master the techniques of piloting.



## Ye-8 Prototype Crash Ended Development of MiG-21 Successor Aircraft

*92UM1254I Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 92 (signed to press 23 Jan 92) pp 22-23, 26-27*

[Article by L. Erenburg: "Fate—*On the Unknown 'MiG' and Its Well-Known Test Pilot*"]

[Text] The accident occurred almost 30 years ago, on 11 Sep 62. On that day test pilot Georgiy Mosolov was conducting the latest flight of the experimental fighter. The aircraft was concluding the program of plant flight testing. Everything was proceeding fine. It only remained to make an acceleration at supersonic speed at an altitude of 15 km [kilometers].

The earth looked like a painting from that altitude. The Moscow River twisted in a silvery ribbon, the forests were singled out from the fields as dark green spots against a light background, the asphalt of the highways stretched in a black ribbon, and several cities were visible at once, one of which—Yegoryevsk—was hundreds of kilometers from the capital.

The pilot clarified his position and shifted his gaze to the instruments once again. He increased the engine RPM, and the aircraft began to cross the speed of sound. The speed reached Mach 1.8, and right then there was a very strong bang in the tail section of the fuselage. It was as if a heavy hammer had hit the fuselage. The aircraft began to shake, as if in a fever, and the RPM of both engine rotors dropped to zero immediately, the "Fire" light came on and smoke began coming into the cockpit from the air-conditioning system.

A sharp braking and lateral vacillations of the aircraft occurred with the stoppage of the engine at such a high speed. The test pilot started to be tossed from side to side, hitting the sides of the cockpit. Mosolov was literally hanging from his straps due to the braking. He tried to gain control of the situation by adjusting the air-intake wedge, but it remained immobile, and the hydraulic system was disabled.

The aircraft began to topple to the left, and he was not able to counter this roll with the stick.

The increasing heel turned into high-speed rolls, and here the test pilot was able to notice out of the corner of his eye that the left wing had been severely damaged. Now Mosolov understood that all of his attempts would be fruitless, the aircraft could not be controlled. Only then did he make the decision to abandon the fighter, and reported that over the air.

The SK rescue system developed at the OKB [Experimental Design Bureau] of A.I. Mikoyan had been installed on this aircraft. It had substantial differences from the SK system that was installed on the first series aircraft of this class, however, on namely this aircraft. Whereas there the exit of the seat from the cockpit occurred with the protection of the canopy against the oncoming air stream, here the canopy did not now protect the pilot (it opened to the side), but was rather jettisoned separately. Ejection was thus restricted to speeds of 800 km/hr.

But Mosolov no longer had time for a further gradual decrease in speed. He manually jettisoned the canopy and grabbed the central drive for ejection right away.

The charge under the seat fired him from the cockpit...

* * *

The aircraft that Mosolov was flying was not quite a conventional experimental prototype. It was called the Ye-8.

It became clear to the developers soon after the creation of the Ye-6 and the start of widespread series production of those aircraft, which received the name of MiG-21, that the potential capabilities of that aircraft were truly inexhaustible and that it could serve as a good base for modifications for various purposes. That is indeed what happened. The MiG-21 was actually modified a record number of times from 1959 to 1972.

The modernization of MiG-21 type aircraft was performed, by and large, along the lines of installing new engines with increased thrust, increasing the fuel reserves on board and fitting it with various equipment and armaments. There were two modifications of the MiG-21, however, that differed significantly in outward appearance.

The first of these profound modifications was the Ye-8 experimental aircraft, and the second was the MiG-21I Analog (an analogue of the Tu-144 passenger aircraft).

One can find many aircraft in the history of domestic and foreign aviation that defined the level of perfection for their times. Some of them, unfortunately, were not further developed despite their highly promising tactical performance characteristics. This occurred for various reasons, chief among which was the absence of a reliable power plant. One of the original aircraft of the Mikoyan OKB, the Ye-8, which was by the intent of its creators to bear the name of MiG-23 in series production, did not escape a similar fate.

The outward appearance of the Ye-8 differed substantially from the standard look of the MiG-21, on the basis of which it was constructed. All preceding aircraft of this firm had a central, frontal air intake, but on this one it was located below, under the cockpit. The nose portion of the fuselage was faired, and was intended for the placement of a radar with a large-diameter antenna. There was still no radar, true, on the first experimental Ye-8/1 and then on the second Ye-8/2. The installation of the new S-23 intercept system, which included the Safir-23 radar and the R-3S air-to-air missiles, and later the R-23T, was planned.

There was still no radar suitable for installation on the aircraft by the time of building of the first flight copy of the Ye-8, and the weight equivalents of it were thus installed in its place. The monitoring and recording apparatus and the telemetry unit were also accommodated in the nose portion along with the weight equivalents.

Small winglets/destabilizers were mounted along the sides of the nose portion of the fuselage. The wing, landing gear and empennage of this aircraft did not differ from the same elements of the MiG-21PF design. The forward landing-gear strut, true, was somewhat altered in appearance—it had a breakaway strut.

There was one more feature that struck the eye—a large fence (supplementary fin) was placed under the tail section of the fuselage. The fence was turned 90° when the landing gear was down, and it was opened after takeoff, significantly increasing directional stability in flight. The lowering and retraction of the fence was interlocked with the retraction and lowering of the landing gear. This very design was used several years later on the MiG-23 aircraft.

There was another innovation on the Ye-8, albeit invisible from the outside—all of the fuel tanks in the fuselage were no longer rubber bag (insert) tanks, as on all the various modifications of the MiG-21. They were tanks of the design that later became widespread on all subsequent MiGs without exception.

The Ye-8 could hold in all—in five fuselage tank compartments and four wing tanks (as on the MiG-21)—3,200 liters of kerosene.

The Ye-8, like the Ye-7, has a system for boundary-layer ejection from the flaps when landing. It had not been activated on either the Ye-8/1 or the Ye-8/2, however.

One of the chief features of the aircraft, simultaneously with the new and progressive aerodynamic configuration, was the new, experimental R21F-300 engine with enhanced thrust. It was somewhat larger than its series predecessor, the R11F2S-300 on the MiG-21PF aircraft, in overall dimensions and weight. Its thrust with afterburners increased from 5,740 to 7,200 kgf. The degree of thrust augmentation for the new engine was quite high and reached 55 percent. The R21F-300 was designed and built at the motor-building OKB headed at the time by Chief Designer I. Metskhvarishvili. Many aviation designers placed great hopes on this twin-rotor engine—which were not, unfortunately, later justified.

The Ye-8 aircraft was created by decree of the government of the USSR as a profound modification of the series-produced MiG-21PF, but it had such innovation of design that it was decided to give it the future index of MiG-23 even in the initial stages.

The Ye-8—like the MiG-21PF—was intended for the defeat of targets in the forward and rear hemispheres in day or night and in good or bad weather conditions—that is, it was to be a multirole, mass front-line fighter/interceptor.

Aasemblies that had already been tried out on the MiG-21 were used for the rest of the Ye-8, which was to simplify the output of the future MiG-23 in series production with the parallel replacement of the MiG-21PF with MiG-23s on the conveyor line.

The winglet in the nose portion of the fuselage had no control system at all, and was located in a wind-vane position in subsonic mode. When the aircraft reached Mach 1 the winglet was mechanically fixed in a neutral position relative to the axis of the aircraft. This altered the position of the focal point and reduced the reserves of longitudinal stability, which were excessive at supersonic speeds. The possibility of sustaining much larger G-forces at supersonic speeds was provided thereby. The Ye-8 aircraft actually could have become a fighter for maneuvering aerial battle as early as the beginning of the 1960s, such as our MiG-29 and the American F-16 are today.

The air intake, located under the fuselage, was executed in a flat, dual-stream mode with a vertical three-position wedge with electrical/hydraulic control. A recess for lowering the forward landing-gear strut was located between the panels of the wedge.

Specialists, including the leading test pilot of the firm, G. Mosolov, liked the aircraft.

The crew was designated for the first experimental copy on 10 May 62 by order of the Minister of the Aviation Industry: the lead pilot was G. Mosolov, back-up was A. Fedotov, the lead engineer was V. Mikoyan, and his assistant was V. Shcheblykin. The mechanic and engine mechanic were V. Kochkin and G. Spitsyn. The lead designer of the motor-building OKB, V. Vedenev, took part in the testing of the aircraft.

Finalizing and adjustment operations were performed in a hangar and on the test-track site for more than a month. A methodological council was finally held on Apr 6, at which the specialists in various fields gave the Ye-8 aircraft the green light.

G. Mosolov made the first flight on 17 Apr 62. The aircraft "went up," but it turned out that the R21F-300 engine was still not fully ready for flight testing. There were actually 11 engine stoppages on forty flights of the first Ye-8/1 flight model, which were almost all preceded by a compressor surge—a phenomenon not only unpleasant, but dangerous as well, for the pilot and the aircraft, since powerful lateral vacillations of the aircraft started therein.

Mosolov flew the Ye-8/1 for 16 hours and 22 minutes. Seemingly not all that much, but there was more than enough unpleasantness with the engine.

The designers at the OKB headed by N. Metskhvarishvili had tried in every way possible to improve the too-small

reserves of gas-dynamic stability of the compressor as early as in the process of flight testing. They replaced the guide vane apparatus of the compressor with a new one, they adjusted the moment of opening of the bleed band of the air from the compressor, they adjusted the automatic fuel system and, finally, the engine itself etc. They were, however, unable to raise the reserves of gas-dynamic stability of the engine, and it remained very sensitive to changes in modes at high speeds.

After the 21st and 25th flights, for example, the monitoring and recording gear, now on the ground, "related" a powerful local overheating due to prolonged surging in the air. The engine again had to be replaced with a new one, now with an expanded nozzle guide-vane apparatus.

* * *

Mosolov lost consciousness immediately after ejection from the pain—he suffered simultaneous fractures of the right arm and left leg in the exit of the ejection seat from the cockpit of the rapidly rotating aircraft due to the excessive speed.

The seat automatically separated from the pilot at low altitude, and the canopy of the rescue parachute opened after that. The test pilot descending under the canopy, occasionally regaining consciousness, was able to see that he had no flight boot on and to understand that he would have to land on one leg—the other was broken. He broke the other in the landing. Before that he had been able, by some superhuman effort, to free his leg from the straps of the parachute where it had become entangled in ejection.

Mosolov landed in a forest not far from the Kolomna-Yegoryevsk highway and the village of Timshino. He was found after an hour by a local inhabitant who was gathering mushrooms, who gave him first aid. Three alert helicopters were looking for the pilot, and he was evacuated 2.5 hours after ejection. Georgiy, accompanied by workers from the flight station, was brought by helicopter to the Central Airfield, and from there to the Hospital imeni S.P. Botkin.

The pilot's condition was extremely grave. The best doctors in the capital gave a discouraging diagnosis. The injuries and fractures Mosolov had were more than enough to send him to the next life—a hemorrhage in the right frontal area of the head, a concussion, a closed fracture of the left femur, a closed fracture of the right shin and right arm etc.

The workers at the OKB, experimental plant and flight station received the news of the tragedy with pain and alarm.

Mosolov was often visited in the hospital by Artem Ivanovich Mikoyan, Grigoriy Aleksandrovich Sedov, colleagues, leading engineers and friends. Industrial engineers and workers at the experimental plant made a so-called moving bed especially for Mosolov with inflatable mattress sections according to a program. That design prevented the formation of bedsores.

Georgiy Mosolov recovered in a year and, being a person with boundless love for his profession, wanted to fly again...

The doctors were categorically against it. Mosolov, however, was able to convince his colleague Aleksandr Fedotov, who later became the chief pilot of the firm and received the utmost fame as the highest class test pilot. Fedotov secretly took Mosolov up on a training flight for the MiG-21U. He began to execute expert-level aerobatic maneuvers in the practice area as usual. These G-forces were simply a pleasure for him, a test pilot in Herculean health, but they were too much for Mosolov after having suffered all of his grave injuries.

The accident he had suffered not long before changed the fate of the test pilot, and crossed out the fate of the aircraft as well. He worked a few more years at his plant. Soon world record-holder and Hero of the Soviet Union G. Mosolov retired. He left the OKB, but he did not cut his ties with aviation, working for several years at the Aviation Department of the Higher Komsomol School, and then as the Aeroflot representative in Finland. Today, 30 years after the Ye-8 accident, honored test pilot of the USSR G. Mosolov went onto pension.

The name of Mosolov has remained in the history of the OKB imeni A.I. Mikoyan and domestic aviation as the name of an outstanding test pilot who made a significant contribution to the cause of testing the MiG aircraft, and the first renowned in domestic aviation for absolute world records on the MiGs.

An authorized commission found the true cause of the accident. It started with the unexpected destruction of a part of a disk in the sixth stage of the engine compressor. That part, broken off during the acceleration (and maximum engine RPM were 11,000-12,000 RPM), instantly sawed through the engine housing and the fuselage skin like a milling cutter. Hitting the right wing in the area of the aileron, it caused its destruction. The disabling of the aileron led in turn to a screw (in a roll) drop from an altitude of 15,000 meters. The sharp reduction in engine thrust led to a powerful surge in the compressor and the air-intake duct. The aircraft became virtually uncontrollable in a spiral descent.

The flights in the second copy of the Ye-8—the Ye-8/2—were made by test pilot A. Fedotov. Thirteen flights were made in all. Flights in the Ye-8/2 were curtailed after Mosolov's accident and were not restarted, despite the good tactical performance characteristics obtained on both aircraft before the accident on 11 Sep 62. This was an impulsive decision by the leaders of the aviation industry. The aircraft could doubtless have been brought to the necessary level of reliability.

The achievements of the Ye-8/1 and Ye-8/2 included maximum speed of 2,230 km/hr, Mach 2.1 and ceiling of 20,000 meters. These were excellent characteristics for an aircraft with a takeoff mass of just 8,200 kg (the mass of the empty aircraft, by the way, was just 5,670 kg).

The creation of the Ye-8 experimental fighter using the basic components that had already been put out in 1962 for the series-produced MiG-21PF aircraft was undoubtedly a progressive step in Soviet aircraft construction, which was, unfortunately, not completed due to the engine that had not been brought to the necessary level of reliability.

Work was already underway at full speed at the OKB by that time on the design engineering of a completely new fighter, the MiG-23, with variable-sweep wings, which also influenced the decision to curtail all work on the Ye-8.

## Western Remotely Piloted Helicopter Reconnaissance Craft Described

*92UM1254J Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 92 (signed to press 23 Jan 92) pp 28-29*

[AVIAINFORM article: "Remotely Piloted Helicopter Reconnaissance Vehicles"]

[Text] *Means of aerial reconnaissance should provide for the continuous surveillance of the battlefield, and pass along intelligence data to the command echelons of the troops in real time to wage modern land battle. These requirements are met to the greatest extent, in the opinion of foreign experts, by remotely piloted helicopters (RPHs). The RPHs, as compared to remotely piloted craft in an aircraft configuration, may be employed from small sites and do not require complicated devices to support takeoff and landing (such as acceleration catapults, parachutes and landing nets).*

*The RPH systems are distinguished by high combat survivability and are considered a more preferable means of regimental and battalion reconnaissance. The principal drawbacks of the RPHs are the comparatively low top speed, flight duration and payload mass.*

*The United States, Canada, Great Britain, Germany and Israel devote a great deal of attention to the development of RPHs. The projects are still of an experimental nature. The RPHs that have been created include free-flying and tethered craft. The merit of the former is that they may be employed for the performance of reconnaissance in depth in the enemy rear, while a feature of the latter is the considerable duration of flight in hover mode.*

*The free-flying RPHs are subdivided by takeoff mass into three groups: light (under 50 kg [kilograms]), medium (150—200 kg) and heavy (up to 1,100 kg).*

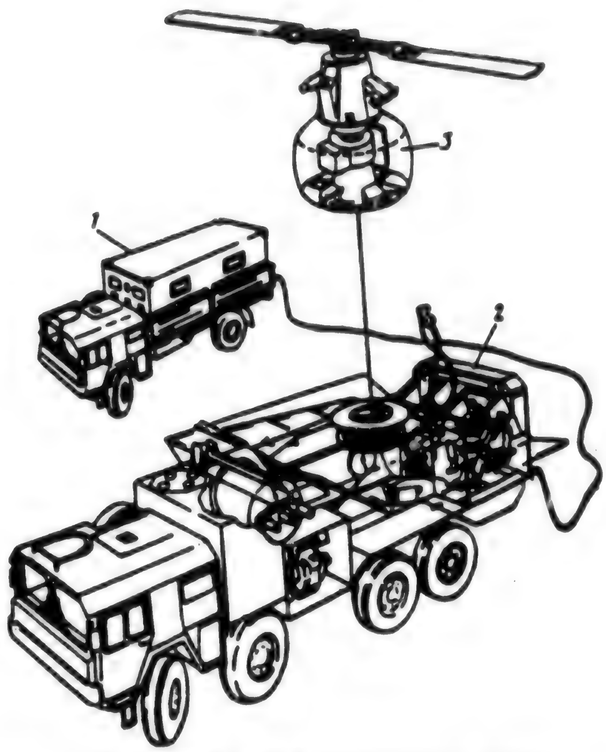
**Great Britain.** The firm of ML Aviation is developing the Sprite RPH on its own initiative. Its flight testing has been underway since 1983. The RPH is distinguished by low takeoff mass (40 kg), which allows a crew of two to carry it manually. The fuselage has a spheroid shape and is divided into four compartments, in which are housed the power plant, fuel and electronic equipment. The latter consists of a computer, autopilot, laser altimeter and data transmission line gear, as well as one of the infrared (IKS), laser rangefinder/target designator (LDTs) or television camera interchangeable systems. All-round scan of the terrain is achieved through the intrinsic rotation of the RPH around the vertical axis. The control of the RPH flight is by radio command or program. The RPH is equipped with two two-cylinder piston engines (PD) with a power of 4.5 kW each. The RPH has a low level of detectability. The low-level infrared signature is achieved by the fact that the engine exhaust is vented out the top portion of the fuselage and mixes rapidly with the cool air. The radar cross-section of the series-produced model is 0.3 $m^2$. The payload mass is six kg, top flying speed is 130 km/hr, flight duration is two hours, fuselage height of one meter and main rotor diameter of 1.6 meters.

**United States.** The Sikorsky firm, on order from the U.S. Navy, is developing the Cipher RPH specifically for use on ships with small displacements. Its fuselage with retractable landing gear has the shape of a ring, in the center of which are located two counter-rotating rotors. The power plant could consist of a gas-turbine engine (GTD) or a piston engine with a rating of 49 kW, each of which has its own merits and drawbacks. The GTD is distinguished by better reliability and the ships have on board the fuel it requires, but it is typified by high cost and large fuel expenditure. The GTD in turn is more economical, but it requires high-octane gasoline. The search for targets is performed via the rotation of the RPH around the vertical axis. The takeoff mass of the craft is 140 kg, with a top speed of 150 km/hr, flight duration of four hours, body diameter of 1.8 meters and takeoff and landing area of 16 $m^2$. The RPH concept was evaluated for a reduced model with a mass of less than 20 kg and a diameter of 1.5 meters. The model was checked out in the modes of hovering and straight-line flight during flight testing that started in 1988.

**Canada.** The Canadian firm of Canadair has been developing the CL-227 Sentinel RPH on its own initiative since 1975. Tethered flight testing started in 1978, and free flving in 1981. The RPH has a fuselage made of fiberglass-reinforeced plastic in modular design, consisting of four sections. The upper compartment holds the power plant and fuel tank, and the lower holds the reconnaissance equipment, computer, flight control system and inertial sensor unit, while the middle compartments hold the reduction gearing and two coaxial three-bladed, counter-rotating rotors. Ring-shaped landing gear is attached to the lower compartment. The RPH is fitted with a 37.3-kW GTD. Flight control is by radio commands or programs. The distance of the RPH from the control station is 50 or 80 km at an altitude of 200 and 500 meters respectively. The RPH is fitted with interchangeable sensors, including a television camera for normal and low levels of illumination, an IKS, LDTs, EW gear etc. The sensors are of modular design, and it takes 30 minutes to replace them. The RPH is characterized by the following data: takeoff mass of 190 kg, payload mass of 45 kg, top flight speed of 130 km/hr, flight duration of four hours, fuselage height of 1.64 meters and rotor diameter of 2.8 meters.

**Israel.** The firm of IAI is developing the Hellstar RPH on order from the Israeli Navy, and it is intended for target designation for antiship missiles when based on missile boats. The RPH is equipped with radar with a detection range of 80-90 km for surface targets and an infrared set. The takeoff mass is 1,100 kg, with a payload mass of 200 kg, top flying speed of 185 km/hr and flight duration of six hours. The flight tests of the RPH began in 1990. It was established during the course of the testing that the RPH can be employed in seas up to sea state 5.

The Hellstar RPH uses a modified fuselage, power plant and other components of the QH-50 ASW RPH that was removed from service with the U.S. Navy.




**Argus remotely piloted reconnaissance system**
**Key:**
**1—control station; 2—transport and launch installation; 3—Do-34 Kibbitz RPH**

**Germany.** The developments of the firm of Dornier are the best known, including the Do-34 Kibbitz that is part of the Argus reconnaissance system. The craft has a conical shape to reduce radar detectability. The on-board equipment is accommodated in the middle portion of the fuselage under a cylindrical housing. The twin-bladed rotary wing is located in the upper part of the fuselage, and it is put into rotation using cold compressed air coming from the tips of the blades. The compressed air is fed from a compressor connected to a turboshaft GTD with a power of 313 kW. The fuel for the power plant comes from a flexible hose from the ground transport and launch installation, which provides for the continuous hovering of the RPH at an altitude of 300 meters for 24 hours.

For the performance of reconnaissance the RPH is fitted with the Orfey-2 radar with a detection range of 70 km for ground targets. After the system arrives in position, the ascent of the RPH to the nominal altitude of 300 meters takes eight minutes. The RPH can be sent up in wind speeds under 14 m/sec. The takeoff mass of the craft is 550 kg, the payload mass is 140 kg, the cable mass is 85 kg (length of 300 meters), the speed of ascent or descent is three meters per second, the height of the RPH is 2.7 meters, the fuselage diameter is two meters and the rotor diameter is eight meters. The flight testing of the RPH began in 1978, and as part of the Argus in 1979. Reconnaissance of individual targets and mechanized columns at various distances was successfully performed during the course of the testing.

The aim of the experimental programs being considered is to create a scientific and technical base for the development of series-produced RPHs. These craft, in the opinion of foreign specialists, are a promising type of armaments and will find application in all branches of the armed forces.



## History of Early Soviet Attempt to Build Manned Lunar Spacecraft

*92UM1254K Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 92 (signed to press 23 Jan 92) pp 40-41*

[Article by Energiya URKTS [universal rocket space transport system] Deputy Chief Designer Candidate of Technical Sciences V. Filin under the rubric "By Reader Request": "The 'N1-L3' Project"; conclusion—for beginning see No. 12, 1991, and No. 1]

[Text] It was necessary to select the energy-absorbing material before creating a physical prototype. The passive configuration made it possible to place it inside the braces and struts. The struts operated only for compression, while the braces had to provide the dissipation of energy both in extension and compression. The first thing that came to mind was to use springs and an ordinary ratchet gear, but according to the compression diagram it could be seen that it absorbed just 50 percent of the energy that was possible. Having considered various types of shock absorbers, we came to the conviction that first foil and then a mesh should be selected for the support pipes, since the force of resistance depended on the one and the other. It was decided to manufacture the inserts of titanium foil via winding on a roll of corrugated ribbon and to bond the layers immediately using spot welding. Such honeycomb inserts had a stable resistance force in compression. But there was one drawback—after operation they were crumpled and were not subject to restoration. Since the craft made just one landing, that was acceptable, but during testing we had to use more than one hundred inserts. But we even extracted a benefit out of that drawback as well—we obtained a great many statistics on the characteristics of the honeycombs. After this arose the next question—the stowage of the supports for the landing device in transport position, since its installation on the lead unit in the operating (open) position was impossible due to the clearances. A means of opening and locking the supports of the landing device was developed for this purpose.

The process of trying out and checking their functioning came up next. Experiments were conducted with various combinations of kinematic parameters and various inclines of the landing surface. The horizontal (lateral) velocity of the drop varied from 0 to 1.5 m/sec, the altitude of the drop varied by several meters and the angle of encounter with the surface varied from +30° to negative values (landing on the side of a slope). Various dimensions of craters were simulated, and more than one drop was required for each change in the conditions so as to eliminate randomness where possible. The tests that were conducted demonstrated the good stability of the configuration for the landing device that was selected. Additional powder engines for counteraction, turned on by a sensing probe when the landing device touched the ground, were also installed to reduce the speed of the encounter with the surface of the moon.

We assumed that the moon landing craft should using the residual energy for the relay of the launch of the lunar takeoff craft, and a television was this placed on the ship.

The means of separation caused us particular anxiety. There were four groups of such elements for the linkage of the frame and the rocket unit. Each of them included an explosive catch that provided a powerful connection, a pusher and a stud bolt. We had to be lucky with them. The point was that the takeoff part was temperature-controlled, but the rest was not. The temperature deformations were considerable. We had to make radial grooves in the frame, and conical ones in the stud bolt. The explosive locks were installed with a back-up explosive charge, and the pusher elements were also backed up. All of the rocket builders knew that the separation elements had to work without failure; otherwise, disaster could not be avoided. The landing craft, aside from the instrument compartment, landing radar, parabolic antennas and chemical batteries for current, had tanks with water for the evaporator, the dose-regulated filling of which made it possible to regulate the position of the center of mass.

We have talked about the autonomous land rehearsals, but all of the stages of it could not substitute for one thing—comprehensive flight practice.

## T2K

It was not possible to do that for the lunar system overall, since the existing rocket boosters, even the Soyuz and the Proton, did not have the necessary lift capacity.

Two new ships—the T1K and the T2K—thus "appeared" in the program of flight practice. They were intended for testing rocket units with standard operation of all of their systems under the conditions of weightlessness. The first served for practicing with the lunar orbital craft on the Proton launch vehicle, and the second for the lunar craft on the Soyuz vehicle. There could, of course, be no question of landing a cosmonaut in the T2K craft.

A cutback in the amount of experimental objects (including the T1K and the T2K) for practicing the lunar system, however, began under pressure from the ministry. The T2K ship remained thanks to the efforts of M. Yangel. There were about 20 systems in it. Their tasks and operating conditions had to be determined. It was essential not to "mess up," as we called it, any essential function of the interaction of the craft's systems. Good logical thinking, encyclopedic knowledge and doggedness were demanded for that. The flight programs were developed by the group of Yu. Labutin. Our leaders Yu. Frumkin and Ye. Ryazanov devoted particular attention to this work.

This group was facing a great responsibility—after all, it was essential to determine uniform conditions for the operation of all systems. It is difficult to imagine, of course, that apparatus in the control system was figured for five Gs, and right next to it the measuring system was figured for one. But when all the operating conditions are taken into account—climatic, vibrational, thermal, dynamic, radiation, space etc.—this process becomes quite complex.

The flight program envisaged the launch of three of the craft. They were not different from each other in composition, but in operating mode the engine installations differed. A standard cycle diagram of the operation of the rocket unit of the lunar craft was simulated in the first launch, and various emergency modes in subsequent ones. The landing devices were not installed on the T2K since they could not be tested in orbit around the Earth, but two additional external instrument compartments were installed instead to obtain additional telemetric information on the operability of all systems.

The question of monitoring the operation of the instruments determining the position of the axes of the lunar craft in flight was a particular one. It was essential to check the work of the solar/planetary sensors. Ion sensors that had acquitted themselves well in space were installed on the T2K for that purpose.

The time came when the flight program was complete, the object had been manufactured and everything was ready for the test range. All sorts of unexpected things started happening for us young people then. It was difficult to surprise the experienced specialists with anything. They started all the testing and check-outs of the object anew, as if there had been no plant quality-control testing. They put the craft in the pressure chamber once again, and then through autonomous and integrated testing. They continued day and night. The craft was finally turned over to be fueled with the gases and coolants for the thermal-regulation system. All of the defects that arose in the check-outs were eliminated in operative fashion. And now here were the final operations. The craft was mounted on the transitional truss of the launch vehicle, and the technological appurtenances were removed. The craft was wrapped up in vacuum/shading insulation and given its nose fairing. Everything. The craft could not be seen. Now to the fueling station—fueling with the oxidizer and fuels for the tanks in the unit and the orientation engines.

The first launch of the lunar craft took place on a sunny morning on 24 Oct 70. It left an indelible impression—the result of the labors of many people for many years, after all, was heading off into the sky. How would the future lunar craft show itself in flight? Had everything been done so that it would fulfill the projected program successfully? The work lasted for many hours. Everything operated fine. The last pulse had been sent, the experiments were concluded. There was not one complaint over that time toward the craft's systems, and that meant we had not worked in vain.

The second launch of the T2K followed on 26 Feb 71, and then the third on 12 Aug 71. All of the tests went successfully. The ground and flight rehearsals of the lunar craft were completed successfully. It was ready to make standard flights. But that time did not come. And there is no blame for the lunar craft in that.

After four unsuccessful launches of the N1 rocket, the project overall was subjected to criticism, and the subject was closed for a number of reasons.

The delivery of lunar soil by the Luna-16 automatic apparatus, whose developers had had to solve quite a few difficult problems, in 1970 was some consolation for us.

Interest in the moon as an object of study was not lost. Its further fundamental study would help answer many problematical questions of the origins and evolution of the solar system.

It would seem that any research of the moon made without the participation of man cannot expand substantially our knowledge of it or create new opportunities for the practical utilization of our natural satellite.

The successful launches of the Energiya launch vehicle with its capability of launching heavy (up to 102 tons) and large (diameter up to 6.7 meters, length up to 42 meters) payloads on external racks are making the assimilation of the moon and the creation of permanently operating expeditionary bases on it realistic in practice. Our country could even now make a substantial contribution to this work. And what was done 20 years ago was not done in vain.



## Usefulness of 'Okean' Oceanographic Satellites Detailed

*92UM1254L Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 92 (signed to press 23 Jan 92) pp 42-43*

[Article by Colonel V. Glebov and Lieutenant-Colonel S. Gorbunov under the rubric "Space Sciences—For the National Economy": "'Okean'—Over the Ocean"]

[Text] *Mankind has always depended on the world's oceans and has always tried to know them. The continuous receipt of global information was required for oceanology and the study of physical, chemical, geological and biological processes, as well as oceanographic photography. That can be provided only through observation from space with the aid of satellites.*

These tasks are performed in this country by the Okean series of artificial Earth satellites. They are placed in orbits close to circular at an altitude of 600-700 km [kilometers] and an inclination of 82.5 degrees. The automatic spacecraft has a mass of about 1.9 tons. The magneto-gravitational system makes it possible to ensure its constant orientation toward the Earth without the expenditure of fuel components through the extension of a weight on a long boom from the satellite body. The time for the active existence of the satellite is thus restricted only by the operable time of the gear—guaranteed for a year, and actually more than three or four times that. There are usually three such satellites operating in orbit simultaneously.

The satellites are fitted with a special on-board measuring system (BIC) and an on-board support system (OBK). The first of them gathers oceanographic information and transmits it to Earth, and has as part of its system radiophysical apparatus (RFA), a radio-television system (RTVK) and apparatus for the gathering and transmission of information (SSPI). The RFA, in order to perform radiophysical measurements, includes a lateral-scan radar set (RLS VO) and a scanning superhigh-frequency radiometer. The mass of the BIC apparatus is about 25 percent of the overall mass of the satellite.

The second system contains systems for electric-power supply, thermal regulation, damping, orientation and stabilization of the satellite and orientation of the solar arrays, as well as command-program and telemetric and trajectory systems with the corresponding antenna and feeder devices.

A whole series of complex scientific and technical problems was able to be solved in the creation of the Okean satellite. This makes it possible to provide for comprehensive observation and the simultaneous accomplishment of radar, radiothermal and optical measurements in a scan strip of 450 km, with the real-time transmission of those data from the satellite both to information receiving centers and directly to consumers with autonomous receiving stations.

The lateral-scan radar provides for the gathering of information in a scan strip of no less than 450 km with a resolution of 1—2 km regardless of the time of day, time of year and presence of clouds, as well as its processing on board the satellite. The photographs taken with the aid of this system make it possible to determine the edges of ice covers, ice clearings and channels through older ice formations, the position and configuration of giant ice fields, zones of high winds and storms, the boundaries of clear water, the position and boundaries of ice floes of varying cohesiveness, icebergs, zones of contamination of the ocean surface, the direction and speed of driving winds and the drift of ice etc. The radar station can provide information, when observing land, on geological and soil structures, the degree of moisture in the soil, the dynamics of the development of the ice cover on lakes and rivers, the boundaries of flood zones and the inundation of banks in the overflow of rivers.

Radiothermal images come from the satellite to Earth with the aid of the superhigh-frequency radiometer, the processing and analysis of which make it possible to specify the age of ice, detect young ice formations, zones of enhanced dampness of the soil and areas of precipitation, determine the moisture content of the atmosphere, the water reserves of clouds, zones of rainfall and the surface temperature of water within a measurable range of temperatures of 100—330°K with a precision of 1—2 degrees, cold and warm currents, areas of storm agitation and the speeds of driving winds with a precision of up to three meters/second.

The collection of information in the visible and close bands of infrared waves is accomplished by the RTVK with multizonal scanning devices with low resolution (no worse than one kilometer in a scan strip of no less than 1,200 km). The radiotelevision images provide information on the cloud cover, ice floes, the presence of pollution on water surfaces, zones of high biological productivity in coastal areas and the open seas, zones where deep waters are raised to the surface, tornadoes, changes in the course and dimensions of ocean currents etc.

The regular gathering of hydrometeorological data from ice and floating buoy stations, and the transmission of that information through the satellite to ground receiving centers with the simultaneous determination of the current geographical coordinates of those stations with a precision of no worse than 3.5 km, is ensured with the aid of the SSPI apparatus. The system is able to support up to 100 stations in sequence on one orbit in a strip of no less than 1,600 km wide.

The Okean satellite thus makes it possible to conduct, from space altitude, all-weather ice reconnaissance scans and, first and foremost in the polar regions, to determine the areas of storms and typhoons by individual ocean areas, the temperature of the water surface and the speed of the driving winds, to ascertain oil pollution on a global scale, to assess the physical state and prospects for the utilization of

fish reserves, to lay out routes for vessels with a regard for ocean currents and the ice situation, to forecast the state of the oceans and the ice situation for navigation, to assess potential reserves of energy from tides and the accumulated energy of solar radiation and to ensure the safety of navigation.

One can cite a host of concrete examples of the use of oceanographic information when performing important national-economic tasks. They include monitoring and covering the ice situation on the area of Wrangel Island for the passage of ships in 1983, the detection and determination of submerged and inundated areas during the summer flooding of the Amur River, observance of oil slicks in the Caribbean Sea as a consequence of a tanker accident in 1984, observance of the areas of drift of the vessel Mikhail Somov, icebound in the Antarctic in 1985, and the regular transmission of information to the autonomous receiving station on board the icebreaker Vladivostok, which was assisting the Mikhail Somov in getting free of its captivity, regular monitoring and coverage of the ice situation in the Sea of Okhotsk for the passage of vessels under the extremely difficult conditions of spring navigation in 1985, determination of the areas of flooding during the spring floods of rivers in the southern part of the European territory of the country in that same year, support for the passage of the Sibir nuclear-powered vessel to the North Pole in 1987, the detection and determination of the borders of the areas of forest fires in Siberia and in the Far East in 1989 and the like.

Fishermen and meteorologists, sailors and chemists, power engineers and geologists, scientists and forestry specialists, agricultural workers and others are in need of regular oceanographic information. A reduction of just 10 percent in the time for the passage of one vessel with a planned duration of 20 days provides an economy of about 150,000 rubles through the use of such data when national-economic cargo is delivered by the Northern Sea Route.

The receipt and recording, processing and dissemination of oceanographic information from the Okean is accomplished by the ground complex of receiving and data-processing equipment that is part of the Main (Moscow) and regional (Novosibirsk, Khabarovsk, Tashkent) centers for the receipt and processing of data, along with a network of autonomous information-receiving points. The latter record and perform real-time analysis of data with transmission to their consumers, including to the regional centers. Magnetic and photographic recording, annotation and geographical linkage of the images obtained with the subsequent transmission of the data to Moscow and the immediate consumers is performed there.



## U.S. Satellites Provided Valuable Data in Gulf War

*92UM1254M Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 92 (signed to press 23 Jan 92) p 43*

[KOSMINFORM report]

[Text] **The United States.** The first days of combat operations by the allied troops in the Persian Gulf zone confirmed the correctness of the American strategy of utilizing space assets for the support of ground operations against Iraq. It is well known that the United States expended more than 100 billion dollars in the 1980s alone for a gradual increase in the number of military satellites and the corresponding ground equipment. The Department of Defense took additional steps to outfit the troops with navigational and meteorological ground terminal equipment for the corresponding space systems in the course of preparing for the combat operations. The high precision of the combat strikes against Iraqi targets, in the evaluation of commentators, was ensured by the fact that the error in the navigational determination of combat aircraft according to the GPS signals was no more than 17.8 meters. The satellites of the weather system made it possible not only to take pictures with images of sandstorms, cloud cover and the like, but also to ascertain operations connected with the use of chemical weapons. Independent experts feel that the Americans could use two or three KH-11 satellites (video reconnaissance), the Lacrosse radar satellites, the three White Cloud groups of naval surveillance satellites, one Magnum and one Vortex electronic-reconnaissance satellite and a satellite from the missile-attack early warning system (the DSP program) to perform reconnaissance in that area.

* The information coming in from the reconnaissance satellites and other reconnaissance systems, according to the statements of one of the carrier-based pilots who took part in the war with Iraq, allowed the A-6E crews to obtain exhaustive data on targets, as well as the approach routes to them and to return to base. As for the mobile Scud missiles, it was essential to find steps to counteract the simple methods of camouflaging them employed by Iraq as quickly as possible. The most valuable information on the locations of the Scud missiles was provided by the Magnum satellite.



## Speculations on Creative Thought of Tsiolkovskiy

*92UM1254N Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 92 (signed to press 23 Jan 92) pp 44-45*

[Article by A. Medenkov and S. Rysakova under the rubric "The Creators of Space Technology": "Illumination—*(Psychology of the Creative Thought of K. Tsiolkovskiy)*"]

[Text] *People who think in a sweeping manner, brilliant and energetic people, are needed in an era of revolutionary changes as in no other. To "reveal" them, help them gain perspective and create the conditions for creativity means to make a real contribution to the cause of developing fundamental research, the generation of new ideas and the awakening of the creative potential of society.*

*That is why it is so important today to address the creative legacy of K. Tsiolkovskiy and to trace the laws for the formulation and development of his ideas, so far ahead of their time. His theory of interplanetary travel and jet aircraft was the launching pad for further research in assimilating outer space. Was the "ingenious dreamer" a brilliant creative personality? What is typical of the psychological point of view for the creative thought of K. Tsiolkovskiy?*

He was undoubtedly a great experimenter, and knew how to find the theoretical dependencies among the values he observed from the results obtained with striking intuition, not fearing to contradict commonly held paradigms. "...Not having a library in my backwater," wrote the scientist, "I worked completely independently, if one does not count the most elementary of scientific data..." K. Tsiolkovskiy relied

in his scientific creativity on a generalized interpretation of the intellectual baggage of empirical experience and diverse knowledge. That made it possible for him to go beyond the bounds of well-known laws of logic. He established a series of most important laws of aerodynamics, especially the dependence between a lengthening of the wing and the forces operating on it and the laws of friction for an air environment. Tsiolkovskiy, despite the prevailing ideas of the necessity of creating aircraft using flapping wings (in imitation of birds), felt that the "birds must be imitated only partly, as much as is possible." He proposed a design for an aircraft that largely anticipated the contemporary monoplane with cantilever wings, and advanced the idea of using a gyroscope on an airplane as the simplest of autopilots. The new knowledge and unexpectedly brilliant solution, in our opinion, came to Konstantin Eduardovich not as the result of a chain of deductions, and were not reduced to logical operations; the transition from one stage (known facts, experimental data) was made intuitively, as a leap of thought.

This process was illuminated especially visibly in an analysis of the works of the scientist touching on the possibility of assimilating outer space. Here such general laws of his creativity can be distinctly traced as an ability to curtail operations, integrity of perception, ability to enrich and develop knowledge (creative synthesis), to carry over and converge concepts, to generate associations, the ability to discern the common in the varied and the like. Nontraditional means and methods of obtaining new knowledge seemingly on the basis of known facts and phenomena are realized in the reasoning of the scholar.

The productivity of the thought of Tsiolkovskiy was doubtless connected with the carryover of known phenomena into new space conditions for his consideration. The solution of this task itself, however, was accomplished not mechanically, but as the result of complex logical constructions.

That became possible largely thanks to the figurative thinking of the scientist. It was no accident that he made this type of assumption toward the reader as well: "Imagine yourself with various small bodies and implements we have taken somewhere in the solar system, further from or closer to Earth."

The freedom of thought of Tsiolkovskiy is based on facts from various realms of knowledge. They include physics and mathematics, chemistry and electricity, biology and astronomy... A high level of concentration of attention on a problem was typical of the reasoning of the scholar. His logical reasoning was consistent both in form and in substance. If he talked about the cooling of a body, he would later without fail dwell on the opposite process—methods of maximum absorption of solar energy by a body.

The thought constructions of Tsiolkovskiy are founded on perceptible ideas that were frequently accompanied by emotional reactions. They are so brilliant that the reader would seem to be convinced immediately—as if the author were really on a path among the stars, and not just in thought: "the sun shines hotly and ceaselessly," "there are various bodies around me." "I cannot believe," he wrote, "that the whole universe is before our eyes, that before us is an abyss without end, without an edge, that that speck there is the Milky Way with billions of blazing suns."

Fantastic assumptions based on generalizations and the integration of baseline data, facts and general laws, rather than associations, are artfully intertwined on the canvas of judgments of the scholar. He sometimes breaks through to new conclusions through a host of assumptions. "We are in absolute emptiness" was the next situation imagined by Tsiolkovskiy. He understood that the gasless space kills instantly, that the rays of the sun were also fatal. "But let us assume"—the scholar "steps over" these "inconveniences"—"that there is neither the one nor the other, that we remain alive."

And later... begins the creative substantiation of the conclusion on the effects of the lack of gravity: "Living bodies can display their muscular strength, make faces, laugh, adopt various expressions, poses, make various movements, think..."

There is no doubt that Konstantin Eduardovich developed the conceptual models of life in interstellar space on the basis of an all-round analysis of everyday life on Earth. The heuristic ideas of the researcher were largely "made concrete" by earthly problems of disinfection, ensuring a comfortable temperature, recovery of wastes etc. This is not, at the same time, the simple copying of earthly experience—everything passes through the "sieve" of the non-earthly way of life and new conditions and factors of habitation. The scholar considers the process of assimilating space itself as part of a dynamic, sequentially analyzing the possibilities for people to adapt to weightlessness and overcome unexpected surprises in interplanetary travel.

The thought of Tsiolkovskiy has a pronounced practical thrust. Conclusions, postulates and deductions are checked for the presence of applied properties. Immediately after mentioning that "the evaporation of a body may be halted completely by shading it," the scholar talks about using that phenomenon as a means of retaining gases and other volatile substances. Considering the effects of eliminating the action of solar rays in interstellar space, he exclaims, "Here is where the possibility will appear for researching the quality of bodies at low temperature and making the greatest of discoveries!"

Tsiolkovskiy strove in his reflections to consider phenomena in comprehensive fashion, from the most varied points of view. That is a feature of his thinking. It is social, bearing a colossal humanitarian energy, which, accumulating from page to page, explodes in concise phrases, for example: "The unity of intelligent forces can be most perfect." It is no accident that according to Tsiolkovskiy, the accommodations for interplanetary settlements should be designed for such a quantity of the members of a community that their individual and common requirements will be "well satisfied."

There is no doubt that during the difficult revolutionary years, K. Tsiolkovskiy, looking into the future, left his descendants more than dreams and theories that were surprising in their practical consequences. He was an example of the heroic labor of a scholar whe gentlemen believe that the HZDS is serious about Slovak sovereignty. He added that anyone who is the first to understand that is at an advantage. It is absurdly nonsensical to claim that the harsher consequences of the reform in the Slovak Republic are the primary reasons for its secession and that Meciar is

preparing to return to a socialist economy. On the contrary, it would be a far more advantageous situation for the purposes of making Slovakia independent if the economic reform were to progress more successfully beyond the Morava River and the Small Carpathian Mountains, than in Bohemia. Then the arguments regarding Slovakia being worse off than the Czechs would sound more credible and national pride could be based on tangible economic results. It is also not true that the very existence of richer and poorer regions leads to the disintegration of the state. It is definitely at least in the interest of less-developed regions to have support in economically stronger territories. Slovakia is not becoming independent because it is economically weaker, but in spite of it. Precisely the fact that the transformation of the economy has greater impact in a weaker Slovakia is the reason why the HZDS has, from the beginning, striven for some kind of form of confederation or union, for that kind of "Czech insurance company."

As far as the practical fulfillment of the HZDS preelection program is concerned, it does not appear that V. Meciar is in too great a hurry to bring about some kind of "softening" of the reform or to pump money into the economy. His first worries involve restriction and a slimming down of the state administrative apparatus. The fact that coupon privatization is expected to be curtailed in Slovakia in favor of "standard privatization methods" can also not be understood as a uniquely leftist activity. The Slovak budget is simply in need of funds which the government intends to acquire through direct sales and that is why it is reducing the amount of property being virtually given away under coupon privatization. The only thing that can attest to the fact that Slovakia is returning to pre-November conditions is the uncompromising progress being made to oppose the lustration law. However, that law had nothing to do with the economy and, for V. Meciar represents not only woeful personal experiences, but is a threat to his power interests.

Representatives of the International Monetary Fund who have met with the Slovak prime minister have spoken of the fact that very few Eastern European politicians are as pragmatic as he is. The crusade against the reform primarily originated as a result of the rebellion against "Pragocentrism." The effort to achieve actual emancipation became visible in the economic area as a result of the rejection of the "Prague reform," which was rightist-oriented, as a result of the coincidence of circumstances. At this moment, it is difficult to say that Slovakia wants to be leftist. In any case, however, we know that it wishes to be sovereign and is going where it wants to go.

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